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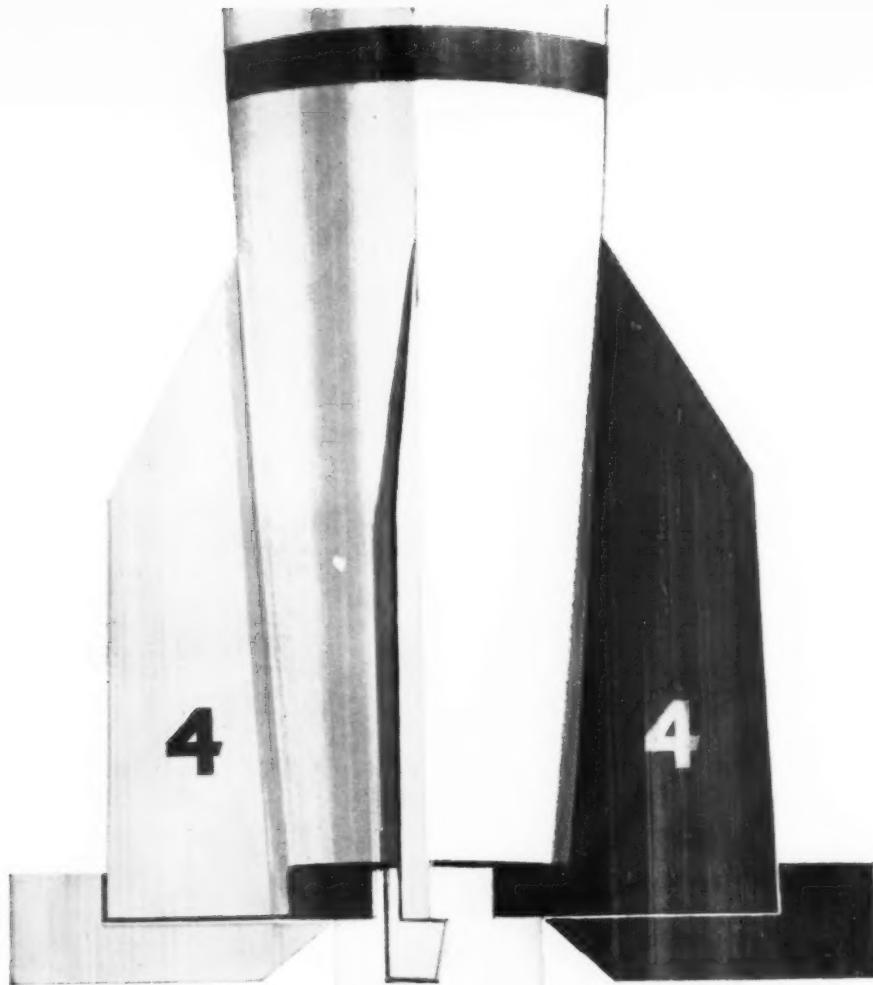


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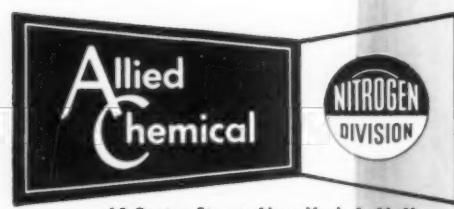
MAY-JUNE 1956



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NOTICE TO NON-MEMBER SUBSCRIBERS

Pursuant to recent action of the Executive Committee of A.F.C.A., non-member subscription rates for the JOURNAL will be changed, effective July 1, as follows: For addresses in U.S., Canada and Mexico, \$6.00 per year; for addresses elsewhere, there will be an additional charge of \$1.00 for postage.

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ARMED FORCES DAY, 1956

By the President of the United States of America, A Proclamation

WHEREAS the armed forces of the United States have steadfastly served as champions of the security of our country; and

WHEREAS the members of the armed forces of the United States are now engaged in tasks which demonstrate to the world our free way of life, our desire to maintain peace with the rest of the world, and our aspiration to insure national security through better international understanding; and

WHEREAS, in order to maintain an essential ready reserve of trained military personnel, the armed forces of the United States are placing added emphasis on a reserve-forces program; and

WHEREAS it is appropriate that the armed forces of this Nation dedicate a special day each year to the demonstration of their operations and capabilities; and

WHEREAS it is desirable that the people of the United States and of the world be apprised of our unified program of Power for Peace; and

WHEREAS it is appropriate that the armed forces invite the public to visit on that day, so far as security requirements permit, posts, camps, stations, bases, vessels, armories, reserve centers, and other facilities:

NOW, THEREFORE, I, DWIGHT D. EISENHOWER, President of the United States of America and Commander in Chief of the armed forces of the United States, do hereby proclaim Saturday, May 19, 1956, as Armed Forces Day; and I direct the Secretary of Defense and the Secretaries of the Army, the Navy, and the Air Force, as well as the Secretary of the Treasury on behalf of the Coast Guard, to mark that day with appropriate ceremonies, to arrange for demonstrations and displays at armed forces installations, to invite participation by representatives of all religious faiths in such ceremonies in order that the interdependence of our security and deep and abiding religious faith of Americans may be recognized, and to work hand in hand with civil authorities in arranging other supporting activities.

I also invite the Governors of the States, Territories, and possessions of the United States to provide for the observance of the day in such appropriate manner as will afford an opportunity for the people of the United States to become better acquainted with their armed forces.

And I call upon my fellow citizens not only to display the flag of the United States on Armed Forces Day, in manifestation of their recognition of the sacrifice and devotion to duty of the members of the armed forces, but also to avail themselves of the opportunity to further their knowledge of our defense posture and of the men and women who constitute our real national strength, by attending and participating in the local observances of the day.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the Seal of the United States of America to be affixed.

DONE at the City of Washington this sixth day of March in the year of our Lord nineteen hundred and fifty-six, and of the Independence of the United States of America the one hundred and eightieth.

DWIGHT D. EISENHOWER

A.F.C.A.—11th ANNUAL MEETING BOSTON, JUNE 14-15

Here Are Up-to-the Minute Program Changes

A.F.C.A.'s eleventh annual meeting—Boston and environs June 14 and 15—has a weather-proof program.

In the unlikely, unexpected and undesired event of inclement weather, the U.S. Navy, which is to be the host service for the Association's gathering this year, has made ample provisions.

For such a contingency, it is planned that early on the morning of June 15 the A.F.C.A. will proceed as scheduled by bus from the Hotel Somerset, Boston to the Naval Air Base at Quonset Point, R.I. There, instead of the cruise aboard the aircraft carrier USS *Antietam*, to observe antisubmarine training operations, the ship will remain in port for a full day's program aboard of exhibits, displays and demonstrations.

While no one is praying for rain, just a mere glance at the *Antietam's* "Baker" program for A.F.C.A.—three typewritten pages—would be enough to convince any interested landlubber that, rain or shine, June 15 is certain to be an interesting and memorable day for the Navy's guests.

Each department of the carrier, first to be built with the so-called canted or angled flight deck to facilitate and speed up take-off and landing operations, is prepared to contribute to the inclement weather program. These include the Air, Medical, Gunnery, Marine Corps detachment, Engineering, Supply, Navigation and Operations departments of this mobile, floating city. Details of these contingency programs are too numerous to list here, but suffice it to say, they cover virtually the entire range of naval organization, equipment and operations, *viz.*, aircraft, catapult device, aviation maintenance and ordnance; fixed guns and other armament; Marine organization and activities; engineering including ship's operation and control equipment and machinery; clothing, equipage and subsistence including a hand-out of hot-from-the-oven samples from the ship's bakery. But that is not all! There are also navigation equipment and procedures, and command functions including the make-up of a "hunter-killer" force for anti-submarine operations.

Additional Features and Changes

At the banquet at the Hotel Somerset on the night of

PROGRAM CORRECTION

The description for the Quonset Point visit with charge of \$8.00 per person, given on the back page of the program and reservation form for the 11th Annual Meeting of A.F.C.A. which has been mailed to all members, erroneously includes the words reception and banquet. These events are not part of the Quonset Point visit and are not covered by the fee of \$8.00.



—Official U. S. Navy Photo

Captain Francis E. Bardwell, Commanding Officer of the USS *ANTIETAM* (left) and his Executive Officer, Commander Arthur M. Ershler, check over the rain or shine programs for "Operation A.F.C.A." June 15.

June 15, the assembled group will include some two-hundred or more students and fifty teachers from high schools and preparatory schools in the Boston area. These are to be guests of the Esso Standard Oil Company which is co-operating with New England Chapter of A.F.C.A. in efforts to promote student interest in science and mathematics. Like many other chapters of the Association, the New England Chapter has been active in the nation-wide move for increasing technical manpower potential.

The Esso Standard Company has arranged to take the selected group of students and teachers for an afternoon's visit to its oil refining plant at Everett, Mass., where the various steps in the oil refining processes will be shown and explained. This is to be followed by a discussion period at the auditorium of the refinery.

In view of the many details to be worked out and the extensive planning involved in this program, a change has been made in the committee in charge. Mr. Howard P. Richardson, vice president of the First of Boston Corporation, has been named chairman of the High School-Teacher Program Committee in place of Brig Gen. James F. McManmon, USAF (Ret.), chairman of the board of Harrington & Richardson Co., Worcester, Mass. The new arrangement will give Mr. Richardson, a resident of Boston, wider opportunity for working out the

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details with the Esso Standard Oil Company. General McManmon will continue as a member of the committee.

The Esso Standard Company's participation in the program has been brought about in part through the cooperation and assistance of Mr. Osgood V. Tracy, president of Enjay Company, Inc., and a director of the Esso Standard Oil Company. Mr. Tracy is a graduate of the U.S. Naval Academy, class of 1924. Following a period of service with the Navy he entered the chemical field. He joined Esso in 1930 and was active in the company's early developments in synthetic rubber, soaps and detergents. He is a member of the American Chemical Society. In 1951 Mr. Tracy was on leave from the company serving as deputy director and later as director of the Chemical Division, National Production Authority, Department of Commerce. Mr. Tracy is to be one of the specially invited guests at the annual banquet.

For the benefit of those A.F.C.A. members who have mislaid the last issue of the JOURNAL, March-April, containing the full program or who may not have seen it, a resume of the two-day meeting schedule is presented in this issue. First, however, there are some additional changes to be noted.

For the afternoon symposium to be held at the Kresge Auditorium of Massachusetts Institute of Technology on June 14 two changes have been made in the program previously announced. Added to the list of speakers is Dr. James F. Black, physical chemist associated with the Esso Research and Engineering company for research on industrial uses for radioactive materials. His topic will be "Oil and the Atom." Dr. Black, a graduate of the University of California (Berkeley) received his Ph.D. degree from Princeton in 1943. He is the author of numerous technical articles in the field of radio-chemistry, member of Phi Beta Kappa, Sigma Xi and the American Chemical Society.



Navy Photo
the USS
Arthur M.
operation

—Kaiden Kazanjian Photo
OSGOOD B. TRACY



DR. JAMES F. BLACK

The Committee on Arrangements for the meeting, headed by Mr. Harry A. Wansker, vice-president of A.F.C.A. and member of the New England Chapter, announces with much regret the withdrawal from the program, for reasons of health, of Dr. John von Neuman, Atomic Energy Commissioner. Dr. von Neuman was scheduled for the afternoon session on June 14 to present a paper on "Some Modern Concepts of Scientific Bases of Weapons Systems." While he is not to prepare the paper and appear at the meeting himself, Dr. von Neuman has, however, very kindly and helpfully suggested his own replacement. Hence the Committee is indeed very happy to announce that Dr. Simon Ramo, Executive Vice President of the Ramo-Wooldridge Corporation of Los Angeles, Calif., will address the meeting. His subject will be "Weapons Systems Engineering and the Changing Role of the Scientist."

It is urgent that wives and daughters of members planning to make the special bus trip for the Ladies' Program on June 14 send in their reservation requests immediately to Mr. Chinery Salmon, Merchants National Bank, P. O. Box 2197, Boston 6, Mass. The trip is limited to the first 100 to apply. To facilitate accounting, registrants are urged to make advance payment of the \$5.00 special fee for this trip.



DR. SIMON RAMO

Dr. Ramo is a member of the Scientific Advisory Board of the U.S. Air Force and a recipient of several awards for outstanding achievement in the scientific and engineering field. Born in Salt Lake City, Utah, he has a bachelor's degree in electrical engineering from the University of Utah and a Ph.D. from the California Institute of Technology. He was formerly director of

Guided Missiles Research and Development with the Hughes Aircraft Company, and later became Vice President for Operations of that company. He is author of two textbooks widely used in universities and holds some 25 patents. He is a member of the American Physical Society, the American Institute of Electrical Engineers, and other professional organizations.



—Convention Bureau, Boston Chamber of Commerce
Old South Meeting House, Boston, Mass. At this house on November 29, 1773, a meeting of 5,000 citizens resolved that tea should not be landed and it was here that the war-whoop was raised that led the way to the tea ships and the famous Boston Tea Party.



—Roy F. Whitehouse Photo
Babson Institute of Business Administration Globe, 28 feet in diameter. Copyright 1955, Babson Institute, printed by permission.

Resume of the Program

Following is a brief summary of the two-day program for the meeting which includes a special program of visits and sightseeing for the wives and daughters of members attending the meeting.

First, it is to be noted that no doubt, for many members, this meeting will provide special opportunity for that "first visit to New England," crowded with landmarks and signposts of American history. As an example, there is presented here a picture of the Old South Meeting house, birthplace of the "Boston Tea Party." Then, by way of contrast, there are such modern wonders as the Babson Institute World Globe, 28 feet in diameter. Those who make the scheduled trip to nearby Wellesley will see it. The program:

Thursday June 14

The Board of Directors meet in closed session at Hotel Somerset at 9:00 a.m., for a business session to include election of officers for the coming year. At 11:00 there will be a general meeting of the members at the Princess Room of the Hotel, when Dr. Per K. Frolich, chief scientist of the Chemical Corps, will speak on the "Reorganization of the Chemical Corps."

In the afternoon, buses will take the members to M.I.T. in nearby Cambridge. There Dr. James R. Killian, Jr., president of the Institute, will welcome the visitors and there will be a program of scientific presentations including "Rocket and Satellite Exploration of the Outer Atmosphere" by Dr. Joseph Kaplan, Chairman of the U.S. National Committee for the International Geophysical Year, National Academy of Sciences, Washington, D.C.

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Dr. Ramo, previously referred to, will speak on "Weapons Systems Engineering and the New Role of the Scientist," Dr. Black on "Oil and the Atom." Captain Francis E. Bardwell, commanding officer of the USS *Antietam*, is also scheduled for a brief address to welcome A.F.C.A. on behalf of the Navy.

Friday June 15

This is to be truly Navy Day. Buses for Quonset Point will start loading at the Hotel Somerset at 5:45 a.m. Male members (300 limitation) and boys sponsored by members (160 limitation) embark on the carrier *Antietam* and the four destroyers (for the boys) for a day's cruise to witness anti-submarine training and flight operations. Featured on this program will be a demonstration of precision flying by the Navy's famous exhibition flight known as the "Blue Angels." They will operate from the Naval Air Base at Quonset Point. Return to Boston will be made in time for the A.F.C.A. president's reception and cocktail party and the banquet.

The banquet speaker is to be Dr. Clifford C. Furnas, Assistant Secretary of Defense (Research and Development). The subject of the address by Dr. Furnas, a scientist and educator now on leave from his position as Chancellor of the University of Buffalo, will be "Molecules—Military and Civilian."

Ladies' Program:

On June 14 there will be a bus tour to include historic Gloucester and Marblehead, and Hawthorne's famed House of Seven Gables at Salem. Luncheon will be provided at the Corinthian Yacht Club, Marblehead, and in the afternoon the group, limited to 100 ladies, will be guests for tea at the Babson Institute of Business Administration in Wellesley. Mrs. Edward B. Hinkley, wife of

Dr. Hinkley, president of the Institute, will pour. Buses for this trip will leave Hotel Somerset at 8:45 a.m. A special assessment of \$5.00 per person for the trip, including the luncheon, will be made.

On Friday, June 15, while the men and boys are at sea aboard the aircraft carrier and the destroyers, the ladies will be entertained with a full day's program at the Naval Air Station at Quonset Point. Buses will leave the hotel in Boston at 9:30 a.m. The ladies will have luncheon at the General Mess at the Station and in the afternoon will visit the various installations there, including aviation control room and weather station. They will be able to observe the special flying operations of the "Blue Angels."

The Committee advises that members planning to attend who have not made hotel reservations do so at once in view of the demand for Boston hotel space in the vacation season.

A.F.C.A. MEETING CHARGES

Registration (all attending)	\$ 2.00
Men and Boys (registration included)	
Full program	25.00
Quonset program only	12.00
Reception and Banquet only	15.00
Women and Girls (registration included)	
Full program (except special bus tour)	21.00
Special Bus Tour (100 limit)	5.00
Quonset program only	8.00
Reception and Banquet only	15.00

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THE ARMY'S ATOMS FOR MEATS PROGRAM

By LT. COL. BELMONT S. EVANS, Cml. Corps

*Office of Research and Development, Office of the
Quartermaster General, Department of the Army*

In this article Colonel Evans tells of the progress and also some of the unsolved problems in a new field of atomic energy research—the preservation of foods by irradiation. This extensive Army project, being conducted under the direction of the Quartermaster General, involves in some of its applications the simultaneous consideration of the three sciences with which the Army Chemical Corps is concerned—chemistry, physics and biology. The Chemical Corps, as well as other government and industrial research agencies, is an active participant in the program.—Ed.

WHENEVER THE WORDS "Atomic Energy" are mentioned in connection with any industry or process, too many people are inclined to nod their heads and sagely assume that another great barrier separating us from the millennium has been surmounted. This attitude unfortunately is a most undesirable one, and it produces a feeling of impatience and resentment when the new technique is not immediately released for general use. The possible use of ionizing radiation for the "cold sterilization" or preserving of foods is in this category; and despite the many glowing forecasts that have been made about its potential, there is still much to be done before irradiated foods will be available for public consumption.

For the Armed Forces this new process offers promise toward reducing the food bill, simplifying logistics, and improving the diet of uniformed personnel, whether it be in an isolated outpost, on or under the sea far from supply bases, or in the air. Think of the savings that could be made if fresh foods could be shipped overseas and stored without the need of utilizing refrigerator freight cars, ships, and storage areas and without the attendant headache of construction and maintenance of these facilities. This could also mean a reduction in losses due to spoilage to a point where many items, now not included in the diet of our overseas or isolated soldiers, would be considered feasible additions to the list of foods available for the best fed soldiers in the world. A reduction in the amount of space occupied by refrigerator equipment on naval vessels would be most welcome. The most vivid example here is that of a submarine, where space is at such a premium that the crew must literally eat their way into whatever cold storage is available to them. The crews of long range bombardment or reconnaissance aircraft would be able to carry complete meals, similar to the pre-cooked frozen meals now available commercially, without requiring freezer space at their base or in the aircraft itself. These are ideals which we would like to be able to attain, but they are not yet here.

Project Launched After World War II

The lethal effect of ionizing radiation on all forms of life has been known for many years, but it was not until the post World War II period that serious consideration began to be given to the use of radiation as a method of food preservation. About 1950 the Atomic Energy Com-

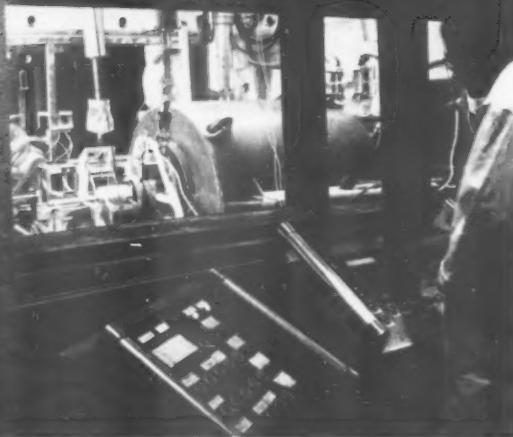


Colonel Evans in 1954 completed a three-year training program in Radiation Defense Engineering which included studies at the U.S. Naval Postgraduate School, Annapolis, Maryland, and also at the University of California at Berkeley, where he received the degree of Master of Bioradiology. He was graduated from the United States Military Academy in 1939, commissioned in the Coast Artillery Corps, and served in Hawaii, the Aleutians, and the Philippines before pursuing advanced studies in physics and chemistry. He attended Columbia University in 1946-7, and was instructor in physics and chemistry at West Point, 1947-50, when he also did part-time work in physics at New York University. Colonel Evans was born at Orange, New Jersey, 28 April 1914, and attended school there. He began his military career with an enlistment, 1932-5, in the 102 Cavalry, New Jersey National Guard. He came to the Chemical Corps on a detail in 1951 and transferred to the Corps in 1955. In 1954 he was assigned to the Radiation Preservation Project of the Quartermaster General, and is currently on duty at the Army Reactors Branch, Reactor Development Division of the Atomic Energy Commission, as a project engineer and liaison between the Quartermaster General and the AEC.

mission lent financial support to several organizations investigating this idea with the primary purpose of utilizing the tremendous amount of energy that was being wasted in stored fission products. The early work of Huber, Brasch, and Waly, with their invention of the capacitors referred to later herein, also focused attention on the potentialities of machine-accelerated electrons. In 1953 a survey of the potentialities of this new method was conducted by the U.S. Army in the Office of the Quartermaster General under the direction of Dr. Ralph G. H. Siu, now Technical Director of the Office of Research and Development Division of the Office of the Quartermaster General. As a result of this study and other considerations, it was decided to concentrate effort in a five-year program under the direction of the Army Quartermaster General.

It is to be noted that the Army Quartermaster is the grocer, the home economist, and the dietitian for the Armed Forces—in fact, he is the greatest single pur-

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Intense gamma radiation is being used to preserve food by irradiation in tests conducted by the Army Chemical Corps at Dugway Proving Ground, under a project sponsored by the Quartermaster Food and Container Institute. A can of food (center), vacuum packed and sealed but not heated, is about to enter the gamma ray field (tank-like structure, center right).

chaser of foods in the world. Since at that time all potentialities for intense radiation sources were under government control, and since it was felt that a concerted effort would in the long run be more economical in money, time and effort, it seemed logical that the program should be directed by a government agency. As paths of promise became more defined, it was planned to have the government effort gradually phase out as private industry became willing to invest capital in pilot or production plants as well as research projects of their own.

A RADIATION STERILIZATION PROJECT under the direction of Dr. Bruce H. Morgan was established as part of the work of the Food Laboratories of the Army Quartermaster Food and Container Institute for the Armed Forces in Chicago. A modest internal program was initiated, but most of the research was set up to be done under contracts with academic and industrial groups that represented every facet of the food processing industry. The Office of the Army Surgeon General, in its role of guardian of the health of the Army, became involved in the supervision of portions of the Project involving nutritional and long-term animal-feeding studies. Other branches of the government were invited to participate in those areas which were of particular interest to them. A number of industrial firms offered cooperation with the program and signed agreements involving only token costs to the government. Now in its third year, the Project has a well organized team operating in all parts of the country trying to whip the problems which must yet be overcome.

Variety of Dose Ranges Studied

There are several dose ranges which appear to be of interest for food processing. The lowest dosages in the range of 8,000 to 15,000 rep* are sufficient to inhibit sprouting in onions and potatoes, apparently indefinitely. Investigations at the University of Michigan and at Brookhaven National Laboratory have shown that sprouting can be inhibited for periods of at least 18 months. However, it must be noted that this dose range is not sufficient to inhibit mold growth, and care must be exercised in storing treated tubers, the same as must be done with untreated vegetables.

A second dose range which is being investigated is that between 30,000 and 50,000 rep to destroy insects and parasites in foods for human consumption. The loss of grains and grain products to insects in this country has been estimated at \$300 million annually. Exposing flour to doses around 30,000 rep will sterilize or kill nearly all insect life in the treated samples, and baking qualities and nutritional characteristics appear to be comparable to those of untreated samples. It must be remembered that radiation of foods does not prevent reinfection or reinfestation, hence packaging properly is of paramount importance. When one irradiates pork at the upper limit of this dose range, it is possible either to destroy or prevent the reproduction of trichinae which may infest the meat. At such low doses the flavor, appearance, acceptability, and wholesomeness appear to be affected only slightly.

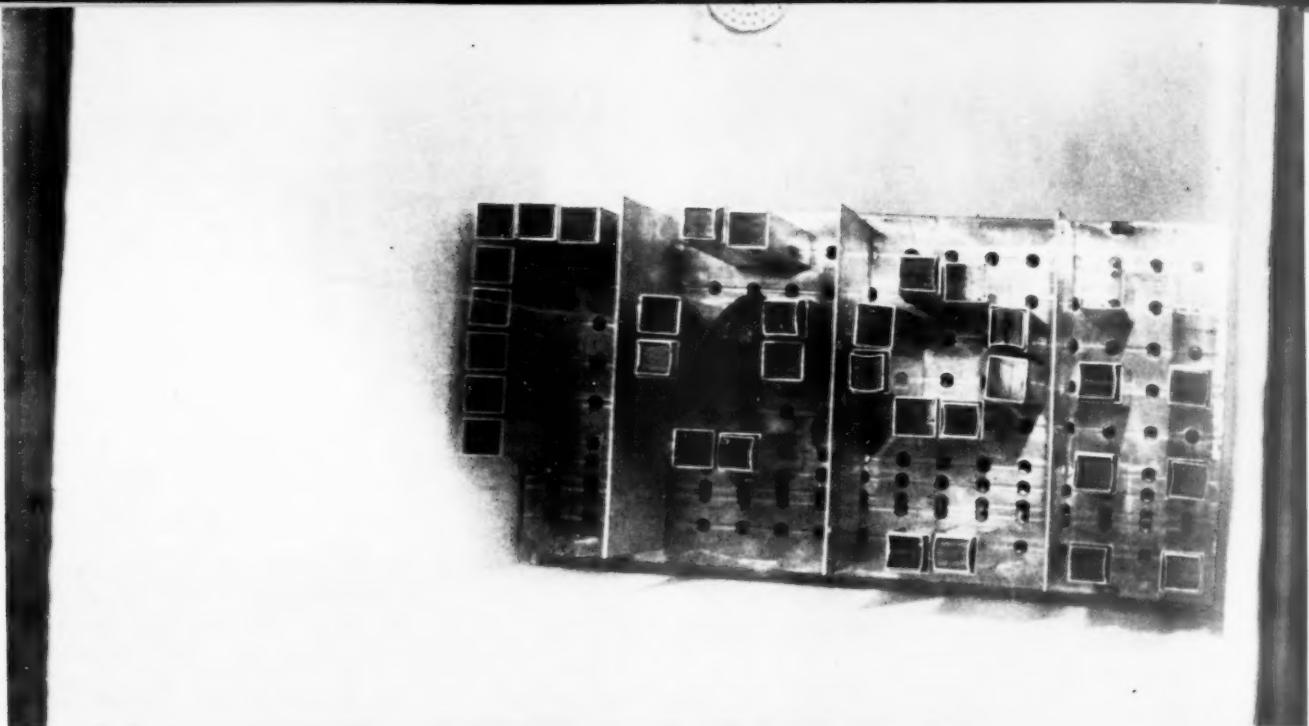
In the range of 100,000 to 200,000 rep we reach the so-called radio-pasteurization dose. The bacterial population of foods so exposed is reduced to a point where shelf life of foods such as pre-wrapped fresh meats kept in refrigerated space may be extended up to five times and smoked meats may have their life span doubled.

At 500,000 rep we reach a point where mold spores are destroyed. This might offer some advantages to partially cooked foods, such as the familiar brown-and-serve bakery products. Further investigation must be made to

Working through about 15 feet of water (which shields him from radioactivity), Phillips Petroleum Company employee lifts a spent Materials Testing Reactor fuel element from the heavy cash which shielded the radioactive element while it was being transferred to the Gamma Irradiation Building canal. In an irradiation facility at the other end of the canal, spent Materials Testing Reactor fuel elements, sources of intense gamma rays, are used to irradiate a variety of materials. Phillips Petroleum Company is operating contractor for MTR gamma facilities, at the AEC's National Reactor Testing Station.



*Abbreviation for "roentgen-equivalent-physical," a unit of measurement of the amount of energy absorbed in items exposed to a radiation.



View from above of the universal-type gamma irradiation grid located in the canal of the Gamma Irradiation Building operated by Phillips Petroleum Company at the Atomic Energy Commission's National Reactor Testing Station. The grid consists of an array of spent Materials Testing Reactor fuel assemblies, powerful sources of gamma rays. The active (fuel-containing) portions of these elements are placed in holders that can be plugged into holes in the grid base. Samples of different sizes and shapes can be accommodated by rearrangement of the elements.

determine if any bacteria that produce toxins may be able to grow easily in items so treated.

Commercial sterilization is reached in doses above two million rep. While most microorganisms have long since given up the ghost by the time this dose has been delivered, some anaerobic sporeformers are extremely radioresistant. The one giving most concern is the Clostridium Botulinum, whose toxin is fatal to man in doses of less than ten micrograms. Since doses of radiation at this level cause undesirable changes in many foods, it would appear that it may well be necessary to combine radiation with other means of preserving foods to process items which are required to have long shelf lives.

Promising Forms of Radiation

OF THE VARIOUS forms of ionizing radiation available, only two seem to offer promise. The other forms can be eliminated for the following reasons:

a. Alpha particles have an extremely limited penetration, hence could be used for surface treatment only. Even for this purpose alpha rays do not seem feasible because of the lack of intense sources.

b. X-rays, which are caused by firing high energy electrons against a heavy metal target, represent only a small fraction of the energy of the electron stream. As much as 95% of the electrons' energy is expended merely in heating the metal target, hence it is deemed more economical to fire the electrons directly at the food items, permitting them to expend the majority of their energy in the target.

c. Due to the probability of inducing radioactivity in exposed foods, neutrons are not considered acceptable. Unlike other subatomic particles, the neutron does not require a threshold energy to penetrate a nucleus, but appears to find capture by target nuclei easier at lower energies than at higher values. It has been stated that even though neutrons may induce radioactivity, the active isotopes so formed have such short half lives that by placing neutron-irradiated foods in storage for a period, the activity will decay to an insignificant level.

But what of molecular changes? For example, take O^{16} in a water molecule. Under certain conditions a n,p (neutron replacing proton) reaction can take place, and we now have the O^{16} transmuted to N^{14} . It is quite improbable that we will form H_2N , and thus we are confronted with the formation of free H and N . N^{14} is a $7\frac{1}{2}$ -second beta emitter, decaying back to O^{16} , and we have the possibility of the recombination of water. But what if this oxygen atom were incorporated originally in an ether linkage or an acid group?

One of the two acceptable forms of radiation is a stream of electrons, produced and accelerated in machines. Four types have been used in connection with the Project:

a. The resonant transformer, produced by the X-Ray Division of General Electric Company. The model most generally used to date is capable of producing up to 0.5 KW of 1 Mev electrons. Recently a new machine which can produce 20 KW of 4 Mev electrons has been in operation at the Milwaukee plant.

b. The Van de Graaff accelerator of High Voltage Engineering Corporation. This machine has been built in various sizes that will produce electrons with energies of 3 Mev. The machine now installed in High Voltage's irradiation facility at Cambridge, Massachusetts, produces $\frac{1}{2}$ KW of 2 Mev electrons.

c. The capacitron, developed by the Electronized Chemicals Corporation, which produces electrons up to $2\frac{1}{2}$ Mev in energy.

d. The linear accelerator, which is produced by:
Applied Radiation Corporation
High Voltage Engineering Corporation
General Electric Company
Varian Associates, Inc.
Metropolitan Vickers, Ltd.

North American Phillips Company, Inc.
Unlike the other types of accelerators listed, the linear accelerator has no apparent limit to the energies which it can impart to electrons except as determined by the design of the particular instrument. Since the penetration of electrons is a linear function of their energy, it

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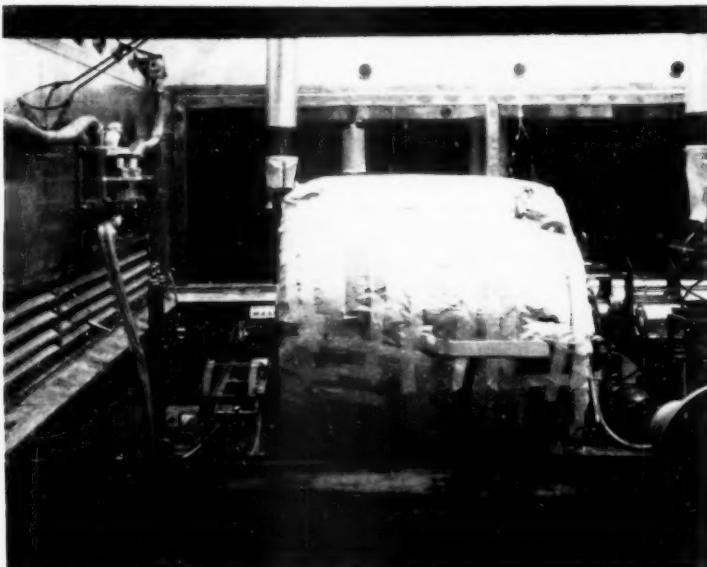
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would seem desirable to design machines of very high energy except for the treatment of small packages, streams of liquids, or grains or other items of similar consistency which can be treated on a conveyor belt. (As a rule of thumb, effective penetration may be computed as $\frac{1}{4}$ inch per Mev, assuming exposure from both sides. Production capacity, assuming about 50% efficiency, is calculated on the basis of 1 KW-hour being equivalent to $\frac{1}{2}$ megarep-ton). However, very high energy electrons may cause induced radioactivity. With energies below 10 Mev, only berillium (toxic by itself) and heavy hydrogen (constituting only 0.0156% of naturally occurring hydrogen) are cause for concern. Research is now being conducted at Argonne Cancer Research Hospital by Dr. Lester Skaggs on this problem of induced activity. A final report of his findings may be available before the end of this year.

Gamma Radiation Sources

GAMMA SOURCES TO DATE have been activated by spent fuel assemblies or elements from the Materials Test-



A view of the spent reactor fuel element facility at Dugway Proving Ground, Utah. The windows through which the facility may be observed are of sufficient thickness to give ample protection to operating personnel from radiation. The 25,000-pound "pot" in the cell is also used as a carrier when transporting the fuel elements outside the cell. In the position shown in the cell the "pot" contains refrigerating coils and a tube to permit the passage of food cans past the eight fuel elements, which are cylindrically arranged in the center of the "pot."

ing Reactor in Idaho and kilocurie cobalt-60 assemblies. The 10,000 curie cobalt source at the University of Michigan is the largest cobalt source in the world. Some food irradiation has been done there in addition to other irradiation projects. At Stanford Research Institute there is a 4,000-curie cobalt source which has been made available for radiation service. Numerous other smaller cobalt sources that have been used include those at Massachusetts Institute of Technology, Argonne Cancer Research Hospital, Naval Research Laboratory, and the Army's Dugway Proving Ground, test station of the Chemical Corps. A new cobalt facility is now being constructed at Dugway Proving Ground, and by the time this is published, the facility may be in operation. This will be activated by five cobalt plates, each expected to have slightly less than 1000 curies of activity, and will be so constructed as to permit variation of dose rate and control of temperature of the irradiation volume from below freezing to temperatures as high as 150° F.

The largest gamma source available for the Project is located at the Materials Testing Reactor at the National Reactor Testing Station outside Arco, Idaho. Periodically, the reactor must be shut down to permit some of the fuel elements, which have used up some of their fissionable material during the operation of the reactor, to be discharged into a canal filled to a depth of eighteen feet with water. Since these "rods" are very hot, both thermally and radioactively, they must be kept under water for a period of weeks before they are moved to a chemical processing plant for the recovery of the fissionable material still remaining in the elements. During this period of "aging," the elements may be used as sources of radiation by placing them in a grid which will permit the existence of a field of radiation of desired uniformity and dose rate. This facility is capable of sterilizing up to 30 tons of food per month, provided the foods are packed so as to permit their immersion in water to a depth of 18 feet.

A smaller facility is now in operation at Argonne National Laboratory in Lemont, Illinois. Twelve Materials Testing Reactor fuel elements have been installed in a water tank about 20 feet deep to serve as a radiation source. Each month four of these elements are replaced by fresher ones from the MTR in order to maintain the source at as high a level of activity as possible. In spite of the amount of activity concentrated here, the Argonne facility is in effect a laboratory tool which will permit the exposure of small lots of samples to doses of radiation with a minimum probable error.

Of particular interest to those associated with the Army Chemical Corps is the major irradiation facility located at Dugway Proving Ground. The source is activated by eight MTR fuel elements arranged in a cylindrical array within a 25,000-pound lead and steel shield. Of historical interest is the fact that this represented the first installation outside of AEC facilities which was issued a license to possess reactor fuel elements. This is the most intense in-air radiation source for neutron-free gamma radiation in this country. With the exception of the steel shell of the shield, all of the apparatus used in the facility was designed and constructed by personnel at Dugway. Inasmuch as this was very much a pioneering effort, a number of unforeseen "headaches" were encountered during the initial days of operation. These included excessive decomposition of coolants, the mechanical headaches of operating, for long periods, a radiation facility by remote control, the problem of determining reliable systems of dosimetry to be used in the megarep range, and others. The information gained here will be of great value to others who will be involved in the design and operation of intense radiation sources at other locations. Most of the operations have been under the direction of Captain George A. Lynch and Major A. L. Steinbach. It is planned to have items of particular interest published in scientific publications at a later date.

Nutritional and Toxicity Tests Made

THE QUESTION OF NUTRITIONAL adequacy of an irradiated diet and the possibility of the formation of toxic compounds in individual foods is being investigated under the direction of the Office of the Surgeon General and the Food and Drug Administration. Before foods may be tasted they are tested for toxicity by being fed to weanling rats for a period of eight weeks. The particular food being investigated constitutes 35% of the dry weight content of the animals' diet. The criterion for clearance for taste testing is that the animals fed the irradiated diet and the control diet must have same growth rate and that no gross pathological differences are observed.

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HOW AGRICULTURAL CONTROL PROGRAMS PREPARE US FOR NATIONAL EMERGENCIES

By FRANK A. TODD, D.V.M.

*Assistant to the Administrator for Emergency Programs, Agricultural Research Service,
U. S. Department of Agriculture*



Elevator completely covered with tarpaulin ready for fumigation against the khapra beetle present in the stored grain. In one operation of this kind, 9½ acres of tarpaulin, 10½ tons of methyl bromide, and 2500 dozen clamps were used to successfully complete the operation.

WE PREFER IN THIS COUNTRY to live without plant and animal diseases rather than with them. Our efforts in this direction, even though the ideal cannot always be reached, have contributed significantly to giving us a highly productive agriculture. But, in the effort to reach a disease-free condition, we have developed livestock and crops that are highly susceptible to the invasion of disease organisms and insect pests.

This high susceptibility gives us many moments of uneasiness in a time when men and animals have a greater mobility than ever before in history—and it is axiomatic that disease moves with man and his animals.

As an example of movement within the country, it is normal practice for three major midwestern stockyards to ship livestock to or through 40 of the 48 states (figure 1). Whether shipments to all these destinations fall within the period of a day or a week, the potential for spreading disease throughout the country in a short space of time is far greater than most people imagine. Add to this the fact that shipments into these stockyards derive from about half of the 40 states. Then add shipments into and out of the other 45 federally inspected stockyards . . .

those into and out of hundreds of local yards . . . the large and constant movement of poultry . . . the livestock auctions . . . the private sales and shipments of all kinds of livestock . . . and some idea can be gained of the tremendous mobility of livestock in this country. A Florida cattleman may not like to believe that an outbreak of animal disease in Oregon can possibly affect him. But, unless detected and stopped from moving through this web of transportation, it could be in his backyard in less than 2 weeks.

Shipment of livestock by sea from Africa, Asia, or Europe takes 15 to 40 days. In the days of sailing vessels it took much longer. Time is on our side in ocean transport, for most diseases can develop in the travel time and control measures can be taken before arrival. But, in 1954, for the first time in history, overseas exports of cattle were greater by air than by ocean vessel. More than 75 percent of the imported poultry enter the country by air, nearly 55 percent of the horses, and 11 percent of the sheep, goats, hogs, and zoo animals. Flight time in most cases is 12 to 14 hours. Travel is so fast that it outruns the period of incubation of nearly all diseases.

Animals entering the country need to be checked both before they leave the country of origin and at quarantine stations in the United States.

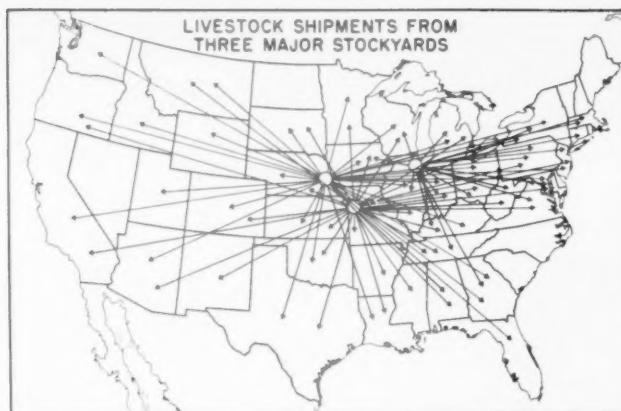
Seventeen times more airplanes are now engaged in foreign travel than before World War II. Almost twice as many ships are inspected. Surface travel across international borders has snowballed. For instance, 4 million motor vehicles crossed the Mexican border in 1939; in 1954 the number was 15 million.

Animal and plant diseases, of course, pay no attention to man-made boundaries—they recognize only the limits



Dr. Frank A. Todd, Assistant to the Administrator for Emergency Programs, Agricultural Research Service, U. S. Department of Agriculture, has been on loan from the U. S. Public Health Service since 1954. He is responsible for agricultural research relationships to national defense, including the safety of crops and livestock. To this end, he serves as liaison with other parts of the Department of Agriculture and with other Government departments and agencies.

Dr. Todd was born September 11, 1911, at Merrill, Iowa. He received the degree of Doctor of Veterinary Medicine at Iowa State College in 1933 and his master's degree in Public Health at Yale University in 1935. Thereafter he joined the Veterinary Corps of the Regular Army, serving in Iceland from 1941 to 1943. Assigned to Supreme Headquarters, Allied Expeditionary Forces in 1944, he served as Chief of the Veterinary Section, coordinating field operations for control of animal diseases during combat in northwest Europe. After the cessation of hostilities he supervised the reestablishment of German veterinary service in the U. S. Zone. Returning to the States in 1948, he was assigned to the General Staff. He was decorated with the Legion of Merit and the Bronze Star. Joining the Public Health Service in 1951, he was detailed to the Federal Civil Defense Administration as a consultant on biological warfare and was later loaned to the Agricultural Research Service. He is Past President of the American Board of Veterinary Public Health and of the Conference of Public Health Veterinarians, and is a member of several technical societies. He has published numerous scientific papers on subjects relating to veterinary medicine.



This map shows graphically the possibilities of the spread of disease in the normal movement of livestock from only three Midwest stockyards.

of their own life cycle and the borders enclosing their host or carrier. They may enter the country as active cases of disease, as most of them undoubtedly did in the earlier years of our history, before passage of quarantine and inspection laws. They may enter in the bodies of healthy carriers, as bluetongue, a disease of sheep, probably came in the body of a cow. Or as African swine fever might come, unless constant vigilance prevents, in the body of a warthog destined to an American zoo. Diseases may come in ship's garbage, as foot-and-mouth disease twice entered the United States; in contaminated vaccine, as foot-and-mouth disease once came; in raw bone-meal, through the channels of commerce, as anthrax came from the East and Near East in 1952; it may come in dried sausage, salami, or other meat delicacies carried in a passenger's baggage, as foot-and-mouth disease entered inland Canada from Germany in 1952. Diseases may come in the bodies of insect vectors, trapped in an airplane. They may come, caught up in the mechanic force of a hurricane or on the feet of migratory birds.

Only the highest form of vigilance, buttressed by the best foreknowledge and ingenuity of science, can screen out and keep out the viruses, the bacteria, the fungi, the insects that are a constant and growing threat to a susceptible American agriculture.

NEWS COMES TO US that some foreign animal diseases are spreading in their own countries and continents. This increases the chances of their being transported to this country.

With so many hazards abroad, there has been a heightened interest in foreign diseases. A specialist from South Africa was invited to the United States after bluetongue was found in the southwest. Americans carry on a lively correspondence with specialists abroad, technical journals are exchanged with all countries, and Americans go abroad to study on their own ground diseases we now consider foreign. Within the past few years, a new lexicon has been added to the language of the American veterinarian—names such as heartwater, Nairobi sheep disease, Teschen disease, East Coast fever, contagious agalactia, Nagana, contagious streptothricosis.

The United States Livestock Sanitary Association has issued a booklet on foreign animal diseases that is in effect a supplement to veterinary texts. The Federal Civil Defense Administration, in cooperation with the Department of Agriculture, has acquired and made films treating on the clinical aspects of various obscure diseases, for showing to technical audiences. Programs have been established and teaching materials have been made available



The application of a fumigant for the destruction of insects that might be present in foreign plane upon arrival. Bottom, Inspection of forage, as well as the animals, is made on each importation to detect possible presence of diseases and injurious insects and to prevent their introduction into the United States from this source.

for presentation to veterinary practitioners, to the staffs and student bodies of veterinary colleges, to diagnostic laboratories and commercial biological houses. The materials are designed to inform technicians of the livestock industry of the hazards of foreign animal diseases, their recognition, diagnosis, prevention, and control. Local and regional meetings are being held, with the assistance of Agricultural Research Service officials, to carry the message of foreign disease and its threat to American livestock.

As if all the other complications were not enough, a number of foreign diseases have symptoms quite similar to those of domestic ailments. African swine fever and Teschen disease have symptoms that are hard to distinguish from hog cholera, swine erysipelas, and nutritional deficiencies caused by lack of vitamins A and D, calcium, phosphorus, and pantothenic acid. Rinderpest, a dread disease of livestock in Africa and Asia, can be readily confused with virus diarrhea of calves and a group of mucosal virus diseases that have recently turned up in various parts of the United States. Tests have

definitely established the fact that rinderpest is different from the mucosal complex. Differential diagnosis in such cases is always a problem. Newcastle disease, now a commonplace in nearly every flock of chickens, can be confused not only with the fatal or so-called Asiatic form but also with the deadly fowl plague. Foot-and-mouth disease and the African "erotic stomatitis" in cattle are almost identical with vesicular stomatitis, which is present at various times in the United States, vesicular exanthema, which has been identified only in this country, and bluetongue, a recent disease import. Rift Valley fever, another African disease, can be confused with enterotoxemia, viriosis in sheep, bluetongue, and Q fever. Another dangerous South and East African disease known technically by a variety of names but popularly as "epivag," which causes bovine sterility, can be wrongly diagnosed as one of several breeding ailments known in this country.

What if some of these diseases should slip into the country and be mistaken for a known and less harmful illness? Fast-moving foot-and-mouth disease spread in one month into 5 Mexican States and eventually into 17. A 5-year cooperative Mexican-United States program of eradication was necessary to wipe it out. The cost was \$127 million to the United States, with enormous additional costs to Mexico. Canadian winter helped in the outbreak to the north of us. The fatal form of Newcastle disease entered the country in 1950, with an importation of game birds from Hong Kong. Quick action by California and Federal authorities eradicated the disease in the state of original entry. Since then, importations of poultry and birds have been inspected and quarantined at the time of arrival. During 1954 and 1955, nine shipments of birds, including chickens, partridges, pheasants, and doves have become ill of this "Asiatic" type of Newcastle disease while in quarantine. The outbreaks were promptly eradicated, preventing introduction of the disease and great losses to the poultry industry.

In another field, the khapra beetle, noted as the world's worst pest of stored grain, entered the United States from the Far East, probably during the aftermath of World War II. Mistaken for the domestic carpet beetle, it went unidentified from 1946 or earlier until 1953. By then it had spread into three states, and millions of dollars are being spent by the States and the Federal Government to eradicate it. Fumigation, an old method, was expanded to a scale never before attempted when large warehouses—containing 1 to 3 million cubic feet of space—were enclosed with acres of tarpaulins, the buildings filled with methyl bromide gas—and 100 percent kill was attained of khapra beetles in all stages.

There is an imperative need to know these serious foreign diseases and pests, to be able to distinguish rapidly between them and their familiar domestic counterparts. If we do not learn to know them before-hand, we are putting an unnecessary handicap on ourselves in the event that any given pest or disease should break through our defenses. We would lack experience with it and be without effective methods of coping with it.

OBVIOUSLY THE FIRST THING to do about these foreign pests is to keep them out if possible. The Federal Government has 16 ocean ports designated for the entry of animal and poultry imports. Inspection and quarantine is mandatory at these points. These precautions have been highly successful in helping to prevent the introduction of many of the serious devastating foreign animal and plant diseases and injurious insects into this country. This precautionary action is not absolute, however, as is illustrated by the introduction of a disease of sheep known as scrapie with an incubation period up to three years.

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Grasshopper fossil of the Jurassic Age, 140 million years ago.
Photo courtesy American Museum of Natural History, New York.

Here yesterday . . . here tomorrow?

In a very old Book, it is written: "The land is as the Garden of Eden before them, and behind them a desolate wilderness, yea, and nothing shall escape them." (Joel 2:3) The reference is to grasshopper damage. In the United States, grasshoppers inflicted heavy crop losses as early as 1797. In 1877, grasshoppers alone were causing 2 million dollars' damage to crops each year. In addition, many other kinds of crop pests were making serious inroads on all types of commercial and food crops. Growers were constantly faced with the spectre of near or total crop destruction.

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such as aldrin, dieldrin, endrin, D-D^(R), and Nemagon are powerful weapons in the "battle of the bugs." They kill fast. In some uses, they kill for months and years after application. These pesticides were born of years of research and vast expenditures of money. But research never stands still! Even now, as these pesticides take their place as leaders throughout the agricultural industry, Shell Chemical has new pest-killing chemicals in the experimental stage. In time, they too will be ready for effective commercial application. And perhaps Mr. Grasshopper may indeed be "here today, gone tomorrow."

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The intercontinental tourist presents a potential hazard. Innocently returning from abroad, he may have in his baggage lavish gifts of meat delicacies from other countries. Many of them, made from ground beef, pork, and veal, are seasoned and dried but not cooked. The meat may have come from animals having a highly infectious disease or from an animal that may carry such a disease. Wishing to spread his largess, he may make gifts to his



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atomic radiation has resulted in the production of a great number of mutations, or, actually, in the creation of new races which it is believed would occur naturally in the course of time. Now, scientists look forward to forcing as many mutations as possible in a relatively short space of time and subjecting various strains of wheat to them. Thus, rather than waiting for these races to develop in nature and then hurrying research to meet the threat after it has actually arrived, it may be possible to leap ahead as far as 50 years within a short space of time, force the potential new races into existence, then develop resistant wheats and have them ready when these potential threats actually occur in nature.

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SCIENCE EDUCATION IN GREATER WASHINGTON

By DR. W. T. READ *

In the following article Dr. Read tells of the ways in which one community has helped stimulate interest in the study of sciences at the secondary school level. Announcement of the winner of A.F.C.A.'s \$1,000 prize to an outstanding secondary school teacher of science or mathematics, in furtherance of the Association's efforts for increasing technical manpower, will be made at the Annual Meeting, June 14-15.

FOR A NUMBER OF YEARS the Washington Academy of Science has maintained a committee for the encouragement of science talent in the secondary schools of Greater Washington. Most of the earlier efforts were devoted to promoting science fairs and recognizing winners in these and in such talent searches as that sponsored by the Westinghouse Corporation.

During the past few years the engineering professions in this region have become increasingly aware of the impending and growing shortages of qualified secondary school students entering colleges and universities for training in sciences and engineering. As a result the District of Columbia Council of Engineering and Architectural Societies, made up of representatives of some twenty-eight professional societies, appointed its own education committee.

Almost immediately the task of interesting more students in taking the necessary training in science and mathematics began to be coordinated between the Academy and the Council. Among some of the accomplishments resulting these are noteworthy.

A Junior Academy of Sciences was organized and has operated successfully for more than four years. It is made up of honor students and winners of talent searches and science fair contests. While it is under the auspices of the Senior Academy and has some older scientists on its governing board, the young people handle a good part of the work, and have general responsibility for the science fair program.

Several organizations have actively supported convocations and lectures, notably the annual popular lecture on chemistry by the Chemical Society of Washington (local section of the American Chemical Society), and the Christmas Lectures, supported by the Philosophical Society. The latter, patterned after the Christmas Lectures on popular science of the Royal Society of London, have been attended by capacity audiences of students of the secondary schools.

A number of students from this region have been winners both in the Westinghouse Talent Search and in the annual fairs of the National Science Clubs. Twice in recent years a student from Greater Washington has won the top Westinghouse prize, a four year scholarship. In 1956, three students from this area were among the forty Westinghouse finalists, one winning first prize and another a one-year scholarship. Apart from national contests a number of others have been granted scholarships in colleges and universities.

*Dr. Read is Scientific Advisor in the Office of the Chief of Research and Development, Department of the Army. He is the immediate past president of the Washington Chapter of A.F.C.A.

Large groups of students have visited museums and science exhibits in New York and Philadelphia as well as local government and educational laboratories. Two essay contests with substantial prizes have been held this year, one for high school students and the other for science and mathematics teachers.

Through a speaker's bureau, several thousand students each year have been informed about the needs and opportunities in the fields of science and engineering. Contacts vary from talks to small groups up to large convocations. The outstanding contributions of scientists and engineers were in the spring of 1956, when more than one thousand volunteers went to the class rooms of Greater Washington to substitute for over four hundred science teachers, while they in turn attended sessions of the National Science Teachers Association. This effort was so successful that many school officials have asked that it be made an annual affair.

Science fairs in this area have now grown to such an extent that instead of one large final fair, four large fairs were held in the spring of 1956, in addition to a number of preliminary school fairs. Two of these were in Maryland, and one each in Virginia and the District of Columbia. Winners are eligible to enter the annual fair of the National Science Clubs.

Realizing the need for a larger and more closely integrated effort, the Washington Academy of Science and the District of Columbia Council of Engineering and Architectural Societies have formed the Joint Board for Science Education to cover Greater Washington. Following are the present committees of the Board: School Contacts, Science Fairs, and Speakers Bureau. The whole area has been divided into regions with leaders for each, and with contacts for each junior and senior high school or academy. Funds have been raised to carry on the work of the Board and to support the four science fairs. Sending fair winners to national contests has been left to each local area.

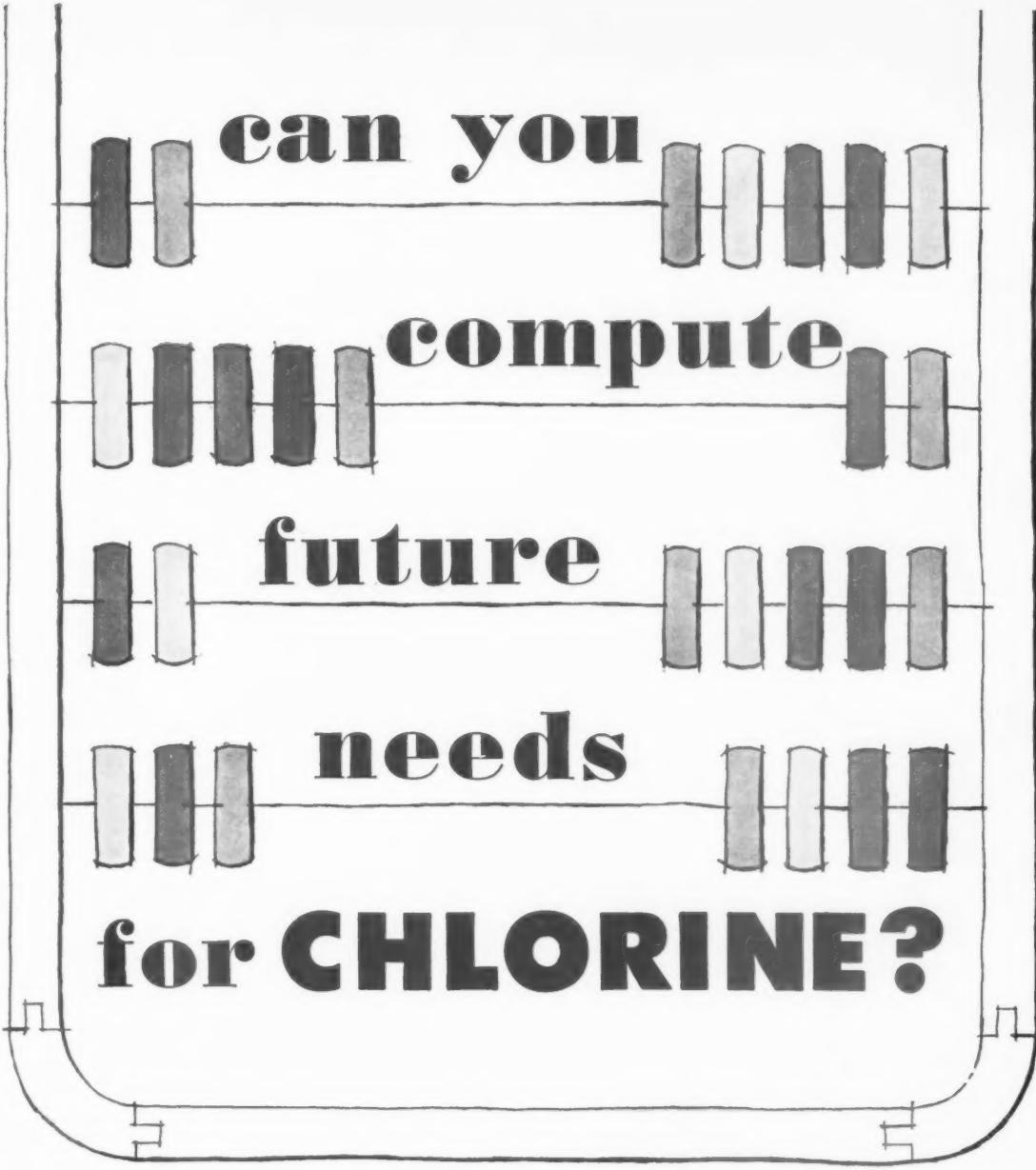
Every effort is being made to support all projects for the improvement of science teaching, and it now appears that a strong and united movement is on its way to assist both teachers and students in every way in the common cause of advancement of science and engineering in Greater Washington.

ADMIRAL PRIME AT PURDUE CHAPTER

Speaking on "Maturity of Graduation," Rear Admiral N. S. Prime, U.S. Navy (Retired), President of A.F.C.A., addressed an enthusiastic meeting of the Purdue Chapter of the Association held at the University campus at Lafayette, Indiana, on April 12. About 100 persons, including student members of the Chapter and friends, were present.

In describing the meeting to the Executive Committee of A.F.C.A. in Washington on April 16, Admiral Prime stated he was most pleased to have had this opportunity to meet with and exchange ideas with this group of undergraduates. He said it was for him an inspiring and gratifying experience. After the address there was an impromptu question and answer period.

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REALISTIC THINKING ABOUT CBR WARFARE

Address delivered at the Second Military-Industrial Conference of the Society of American Military Engineers, held in Chicago February 9-10, 1956.* Printed here through courtesy of the Society.

IN PRESIDENT EISENHOWER's message to this conference, he stated:

"We can continue to maintain adequate defense for the United States and furnish adequate military support for the rest of the free world only so long as we continue our leadership in the exploitation of technological advances which already have provided us with new and superior weapons."

In considering all of the possibilities with which we may be faced if our statesmen and diplomats are unsuccessful in preventing war through peaceful negotiation, it is imperative that no potentially important technological aspects be overlooked.

One of the very important areas wherein the technology of the United States could play a vital part is the entire field of effort which falls under the classification of what we in the military services term "CBR warfare."

The features of CBR warfare, however, actually suffer from a greater lack of understanding than perhaps any other aspects of our national defense program. There has been more misinformation—perhaps some of it deliberate—about "germ warfare"—or "poison gas"—than about any other forms which war may take.

What sort of a feeling do these terms develop in your minds? Can you consider them rationally and unemotionally, or perhaps do even your minds rebel at giving adequate consideration to these possible means of warfare?

If any of you have accepted the point of view which the Communist propagandists have attempted to force on the world—and one to which even some of our own editorial writers appear to have succumbed—you may be suffering from an irrational phobia based on lack of information—or actual misinformation—on a subject which could be of utmost concern to each of you, both as individual citizens and as leaders in your professions.

It is the need for realistic thinking on this subject which I want to discuss with you today. I am extremely happy that I have been offered this opportunity to present some information on CBR warfare to such an outstanding group of military and industrial leaders.

There are two aspects in the consideration of any form of warfare—defense and offense. The defensive aspects are of primary concern to the "home front" and may be of the greatest interest to members of this conference, but we must not overlook the fact that the capability for a strong offense is also a good means for preventing an enemy attack. A sound program for maintaining our technological superiority in all fields is one of the effective means of actually preventing war.

By COLONEL JOHN J. HAYES

*Commanding Officer
Chemical Corps Biological Warfare Laboratories
Fort Detrick, Frederick, Maryland*



Colonel Hayes was educated at Washington University in St. Louis, Mo. and at the Catholic University of America in Washington, D.C. in the fields of Chemical Engineering and Public Welfare Administration.

He commenced his military career in 1934 with Co. D, 138th Inf., Missouri National Guard and was originally commissioned in 1935 as a 2nd Lt., CAC, NGUS. He was transferred to the Chemical Warfare Service Reserve in 1937 and was integrated into the Regular Army in 1946.

In World War II Colonel Hayes served overseas for more than three years and participated in the campaigns in North Africa, Corsica-Elba, Italy, Southern France and the Rhineland. A great deal of his combat experience was with the French Army.

Colonel Hayes has commanded the Indianapolis Chemical Warfare Depot, served as Chief of the Budget and Fiscal Office and as the first Comptroller of the Chemical Corps, and has also commanded Pine Bluff Arsenal, Arkansas. Since September 30, 1953, he has been in command of Fort Detrick, Frederick, Maryland, the biological warfare research and development center of the Chemical Corps (formerly Camp Detrick).

IT IS THE responsibility of the Army Chemical Corps to develop the capability for both defense and offense in the chemical and biological warfare fields, and for defense in the radiological warfare field. In carrying out our responsibilities, we work very closely with other governmental agencies such as the U. S. Public Health Service, the Federal Civil Defense Administration, and the Department of Agriculture. Information on our developments in the protective field is made immediately available to these agencies so that, where applicable, they may be incorporated into public health and civil defense programs.

Before considering some of the means which we have developed to reduce the possibility of a successful enemy attack using CBR weapons on our cities and homes, I would like to give you a realistic picture of the hazards that face us from this form of attack if we continue the complacency with which the citizens of the United States normally consider their possible future.

World War II taught us several important lessons

*Midwest Chapter of A.F.C.A., with Headquarters in Chicago, was one of a number of other patriotic organizations participating as co-sponsors of the meeting.

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which should not be overlooked. One was the fact that in a modern global war, the "home front" is as important a target, and sometimes more so, than the actual battlefield. A second was that mass destruction of facilities essential to a nation's economy—its homes, plants, factories—can, in the long run, prove as costly to the victor as to the vanquished. The interdependence of all nations in today's economy is such that the facilities of no one nation can be destroyed without ultimately causing a serious drain on the economies of all other nations.

Thus any attack on the American home front might well be aimed largely at the human element in order to neutralize our great productive industrial capacity so necessary to supply the fighting forces while still preserving the facilities themselves for their post-war economic value. Since machines need men to operate them, an enemy attack may well be aimed at neutralizing the productive value of the machines by removing their human operators.

The use of atomic weapons, high explosives, heat, and missile-type weapons causes physical destruction not only to the human element, but also to the buildings and machines which those humans operate, whereas poisoning, infection, radioactivity and starvation can cause death or debilitation among humans, but do not destroy material things.

For targets which do not contain productive facilities, for which he might have future use, an enemy would probably use the weapons that cause maximum destruction, while for targets whose facilities he may desire to preserve, he might well use CBR weapons which can remove the human element but leave the buildings and machines intact.

AGAIN, FROM OUR viewpoint as the potential targets, he might desire merely to debilitate instead of kill, for the machines would need people to operate them at the conclusion of hostilities. If he can keep the human element away from the machines through illness or other debilitating means during combat, he will have achieved his purpose of neutralizing the war productivity of those machines. And he will have kept the manpower available for post-war use, even if only in the form of would-be slave labor—for naturally, any enemy attacking our great nation would think only of victory.

On this basis, then, any foresighted person is forced to conclude that the threat from chemical and biological weapons may be just as great as is the threat from atomic weapons. This hazard is often not adequately appreciated since the chemical and biological agents are generally invisible in action, while the effects of the physical destruction weapons can be seen immediately.

These are not invincible weapons, however, nor are they weapons which should produce in the minds of the general public an unhealthy fear because there are means for providing protection against them if adequate preparations are made in advance and if there is a realistic appreciation of their potentialities.

In this respect, a sensible attitude toward chemical and biological weapons could be likened to that which we have toward fire. We all fear fire and with good reason. Other than the automobile, there is probably no other single destructive force that brings about so much loss of life and property. The fear of death by burning ranks as the most feared of all possible ways of dying. We have all been trained to be intelligently aware of the dangers of fire and to act rationally when faced by this threat. If a fire alarm were to sound in this building now, our survival might largely depend upon whether or not our fear of fire is a healthy, rational one under intelligent control which would permit us to file out of the building in an



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efficient, orderly and rapid manner which would probably save our lives, or whether we would all madly scramble for the nearest exit. The same situation could exist with respect to a CBR attack.

In considering all of the possible means that an enemy might take to cause us bodily harm, we may actually be thinking in terms of degree of physical hurt.

Let us consider this in terms we all understand. Suppose we were to walk through a hospital in one of our big cities after one of our normal "peaceful" holiday week-ends. There we would find many persons in the accident ward, where we would hear the injured cry out or moan in pain because of various degrees of bodily injury, some dying in agony, others maimed or scarred for life. We could then pass into the quiet of another ward, where the respiratory or other disease victims lie; some might be dying, but quietly. Others will return to normal life unmaimed after varying lengths of stay in the hospital. And as you consider these two types of wards, always bear in mind that if the accident ward is the smaller of the two, it may be because many of the people who might have occupied beds in that ward are already dead as the result of their injuries.

IN WARFARE, casualties among personnel can be caused by different means: (1) mechanical injury, (2) heat, (3) poisoning, (4) infection, (5) radioactivity and (6) starvation.

The mechanical injury, or wounded victims, and the heat victims would be comparable to those in the hospital accident ward; but disabled by the impact of atomic and high-explosive munitions or missile-type weapons, or burned by the heat and flame of the atomic bomb, the incendiary bomb, or the flamethrower.

The poisoning, infection, radioactivity, and starvation victims would be comparable to those we saw in the respiratory or other disease ward; their bodies weakened by various forms of illness, some deadly, and some not. For, unlike the mechanical injury and heat means of causing casualties, the latter four can be controlled as to their lethality to a great extent through the choice of agents and munitions used to cause the desired effect.

It should be noted that the first two means of causing casualties, by mechanical injury and heat, are the conventional means of warfare; and that the user, once he has set them in motion, has no idea whether they will kill or debilitate the target victims. And we must not overlook the fact that they not only cause casualties, but also cause physical destruction of structures and other man-made or natural objects.

From a CBR attack we might expect casualties which result from poisoning, infectious disease, or starvation—effects which could be immediately lethal (and mercifully so) or merely debilitating.

The Chemical Corps, working with other agencies of the national and civil defense program, as well as with industry, has developed a large number of protective items which are, or could be, available to the public. However, the Chemical Corps develops these items primarily for the use of the armed forces on funds budgeted in Department of Defense appropriations. The funds for their procurement for public use must be provided by Congress through the Federal Civil Defense Administration program, or some other means found for making them publicly available.

In order to give you a clearer picture of just what items could be available for public use and how they might be utilized for civil defense, let us consider a hypothetical long-range attack on one of our vital industrial centers such as the city of Chicago.

Because of its strategic value, the city might be under

attack by the enemy to neutralize its war-making potential or as a vital communications center, but the enemy has a foreseeable need for the city's facilities in the post-war period and is attempting to accomplish its objectives by using the non-destructive effects of its CBR weapons.

FROM THE point of view of defense, the first problem will be to know when the enemy has staged a chemical or biological attack. Since the agents which may possibly be used in these fields are not easily detected, this is not a simple problem. However, it is not an insurmountable one. We have already developed some solutions to this problem.

If the attack launched is one using chemical agents, there have been developed automatic alarms which give visual or audible signals when the mechanism detects minute quantities of toxic gas in the air. These alarms are of two types: large permanently installed apparatus for use in building or industrial plants, and other smaller, portable models which can be used at widely scattered locations within the city. These alarms will detect that a toxic agent is present in the air. It is then necessary to identify the particular type of agent which has been used. For toxic gases, we have simple identification sets which personnel need very little training to learn how to operate.

If the attack launched was one using biological warfare agents, the detection problem is much more difficult. However, assisted by research personnel from educational institutions and industry, scientists at Fort Detrick recently announced the development of an instrument which works on a light reflection principle which will count microscopic airborne particles, germs or dust many times faster than any other previous method. The instrument may be useful to indicate the presence of unduly large amounts of foreign matter in the air, thus giving us an alert that a biological warfare attack may have been made. In the case of such agents, however, the mere knowledge that an unusual amount of bacteria are in the air is not enough since the atmosphere normally contains various bacteria—some harmful, some not. We must know as soon as possible what kind of organisms make up the unusual concentration detected.

Again working with industrial firms, the Chemical Corps has developed a sampling device, corollary equipment and procedures which make it possible to isolate large quantities of suspected bacteria from the air and identify their type within a few hours. Early identification of the organism used makes it possible to treat persons who may have been exposed and to take necessary steps to protect other personnel in the critical areas through mass immunizations or other public health measures.

In the radiological defense field, the Chemical Corps has developed a new type of dosimeter which detects and measures the amount of radiation to which victims may have been subjected. This new dosimeter works on a chemical liquid color-change principle and is easier to "read" than the older photo-badge and electrical charge types.

These, then, are some of the means which we have developed to detect and warn us that the city has been subjected to an enemy chemical, biological or radiological attack.

The detection and identification of CBR agents alone, however, would be of little use if we did not also have some means of providing protection. Protection of a community falls into various categories: protection of the individual, and collective protection of the family or larger groups of individuals.

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FAMOUS LIGHTHOUSES OF AMERICA

STANNARD ROCK LIGHTHOUSE, Lake Superior, Michigan. is located about 23 miles southeast of Manitou Island. Completed in 1883, the stone tower is built on a base of concrete and stone which stands on solid rock in 11 feet of water. The light, 102 feet above water and visible for 18 miles, protects shipping in a dangerous area on the heavily traveled trade route between Duluth and the lower lakes.

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The primary means of protection and fortunately the most widely understood and appreciated means, is the individual protective mask, probably more commonly known to you as the gas mask. The masks which are available today have been developed to the point where they protect not only against poisonous chemical vapors, but also against bacterial aerosols or radioactive dust.

Specifically developed for civil defense use, there is a lightweight pocket size mask which should cost only about \$2.00 to produce, much less than the cost of the World War II type civilian mask.

The protective mask will defend an individual against contaminated air which he may breathe. However, there are also some toxic agents which attack the body through the skin. For these agents, we have developed impermeable clothing made of butyl rubber which is airtight. This item, however, will probably never be used widely for other than civil defense personnel whose duties may require them to enter heavily contaminated areas. We are also experimenting with expendable plastic suits which may offer the wearer protection for from 15 to 60 minutes.

For protection of small groups such as the family, we have developed a gas-aerosol filter material, a "diffusion board," which is made of fiber impregnated with activated charcoal and looks very much like ordinary wallboard. Although it is so made that air can pass through it quite freely, it also filters out biological agents and atomic or radioactive dusts. The board has excellent gas-arresting properties and operates just as efficiently as a forced-flow type of filter. Family-type bomb shelters should be lined with it. While it allows filtered air to enter the shelter, there is also an outward diffusion of carbon dioxide and moisture vapors generated by the occupants of the shelter. The "diffusion board" is inexpensive and can be sawed, planed and nailed just like any common wallboard.

For larger scale use, such as a public bomb shelter, the Chemical Corps has provided the large mechanical collective protector. This piece of equipment is for use in shelters which can be made reasonably air-tight and works on the same principle as that of the canister of the protective mask. It is motor-powered and can force air through a series of particulates and chemical filters at the rate of 600 to 5,000 cubic feet per minute, thus furnishing clean, uncontaminated air to a large number of people inside the shelter. The shelters where these protectors are put into use must be relatively air-tight so that positive air pressure can be built up and they must be equipped with air lock doors. The positive pressure system and the air lock doors insure that all air movement is outward from the shelter itself, thus preventing contaminated air from seeping into the shelter.

Patients in hospitals pose special problems in the matter of collective protection since there are obviously many who could not be moved. For such situations, we have special protective masks for those with head injuries; for the bedridden, we have six-person collective protectors where each individual mask is supplied clean air from a common canister; and we also have infant protectors which are rectangular boxes consisting in part of the gas-aerosol filter material, semi-clear plastic for vision, and a rigid bottom to support the child.

If the enemy has used nerve gas in his attack and there are victims who either have not had a protective mask available or have failed to don it in sufficient time, the back pressure-arm lift method of artificial respiration has been developed. We also have atropine syringes which if used within 30 seconds after the first symptoms appear in a victim of nerve gas will help counteract the action of the agent. For military use, we consider these syringes just as much of the individual protective

equipment of the soldier as we do his protective mask.

In addition to mechanical means of protection, as far as biological warfare agents are concerned, there is also the possibility of providing medical protection through immunization. In this area, there are many agencies both within the Defense Department, in the civilian medical field, in research institutions and in industry which are working on this form of protection of the individual. The Chemical Corps has also done a great deal in developing this aspect of protection.

For instance, last fall we announced the development of a vaccine which has great promise for affording protection to humans against the disease anthrax, thus reducing a potential threat from enemy attack and at the same time providing a means of combating a disease which is a problem in some industrial plants. In conjunction with the public health service, we are now conducting a large scale test of this vaccine in the Philadelphia area, where there has been a noticeable incidence of anthrax among the workers in wool-processing plants.

We have had a great deal of assistance from a well known pharmaceutical firm in perfecting multiple vaccines, that is, one immunization which will simultaneously provide the means of protection against a number of diseases. Any of you who have served with the Armed Forces and have had to take a number of "shots" to protect you against various diseases will appreciate what an asset this development will be.

The mere possession of these items within the Chemical Corps or the Defense Department, or even the knowledge by you and by our civil defense leaders that they are there, is not enough however. There must also be a general public recognition that CBR weapons present a real threat to our safety as a nation, along with a public recognition that these are not "mass destruction" or "horror" weapons, but that means of protection against them have been developed. With this realization, and with wholehearted public support for the civil defense program, a way will be found to incorporate these developments into the defensive plans for every city and industrial area. This is something that must be done.

Today the passive defense capability of our "home front" is just as important as is the offensive capability for retaliating weapon-for-weapon on the "battlefront." A strong civil defense program is a necessary counterpart to a strong military defense program. Not only may it assist in deterring an enemy from attacking our nation, but if he does, a strong defense system may well nullify much of the effect which he hopes to achieve by an attack on the United States.

Up to this point, I have been discussing CBR warfare as we might have to face it if it were launched against us. Now let us look at another side of the picture, as far as this means of warfare is concerned.

I would like to read you some thoughts expressed in an editorial in the *Florida Times Union*, Jacksonville, Fla., on the 8th of November 1955:

"Destruction of life and property has been characteristic of all war; but, despite this, the destruction has been merely a means to an end, not an end in itself.

"The universal aim of war is to destroy the enemy's will to resist the imposition of one's own will upon him. Even the victim of aggression makes war in order to impose his will to be free and independent of him whose will it is that he should lose his freedom and independence.

"The military leader, no less than the statesman, desires to break the enemy's will to resist with a minimum loss of life and property. Both people and property are necessary 'bases on which a peace can be built.' A decimated and crippled population and ruined factories and

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farms are a handicap to the victor as well as to the vanquished.

"Modern concepts of warfare are based upon a corollary principle. If destruction cannot be avoided, it is best that it be accomplished quickly and thoroughly before the enemy can destroy your own population and property. This is the principle of the blitzkrieg and push-button mass nuclear devastation. It assumes that a war can be won in a lightning stroke, leaving the victor with the capacity to rebuild what he has destroyed.

"Nuclear weapons suggest the possibility of breaking the enemy's will with speed and destructiveness. Biological, radiological and chemical weapons hold out the hope of a direct destruction of the will to resist without killing or producing permanent injury."

The Army does not believe that all wars can be won quickly and easily with any one weapon. The means must be versatile and flexible since wars may be general or limited. However, that editorial succinctly expresses much of our feeling in the Army Chemical Corps with respect to the use of CBR weapons if the United States is ever forced to go to war again.

Perhaps the greatest advantage of CBR weapons as potential means of warfare is their selectivity. If lethal effects are desired, they can act quickly, silently and much more mercifully than other means of causing death to enemy forces. They could have been a boon in World War II in the island-hopping assaults in the Pacific and might have reduced tremendously the casualties of our own amphibious forces. On the other hand, if so desired, they can merely incapacitate depending upon the dosage and the type of agent selected. With BW agents, there is a whole spectrum of possibilities ranging from a very mild effect lasting only a few hours, to a long period of disability with ultimate recovery. Rather than being considered a horrible means of waging war, it is perhaps the most humane of all possible means.

Or, if the desire is solely to weaken a nation's will to resist without inflicting either death or disease upon human beings, and again without destroying property, it is possible to attack only domestic animals and/or crops. Antifood warfare is a concept which should not be overlooked as a strong possibility, particularly as a powerful deterrent against forces which rely on large masses of manpower as one of their important war-making potentials.

It is obvious to you gentlemen that, for security reasons, I can really say very little about the offensive aspects of CBR warfare. It is a field, however, in which the tremendous industrial capacity of the U. S. can provide us with technological advantages which may be of powerful assistance as a deterrent to another war.

I thank you.

NEW POST FOR LEW TERRY

Mr. Lewis I. Terry, past President of Midwest Chapter of A.F.C.A. and long associated with Corn Products Refining Company as Senior Chemical Engineer, has joined the staff of Dearborn Chemical Company, Chicago, as Coordinator of Development Work. Mr. Terry served in the Chemical Corps as Chief Chemist with the Production Division at Edgewood Arsenal, Maryland. He has a Bachelor's degree in chemistry from Duke University and a Master's degree in organic chemistry from Boston University.



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EIGHTY YEARS AT ELI LILLY AND COMPANY

By D. STANLEY GEISER

Staff Associate, Employee Communications
and Public Relations Division

FROM BOMBAY, INDIA, to Basingstoke, England, the name Lilly has a familiar ring. For, in some 120 free countries of the world, Eli Lilly and Company markets some or all of its 1,200 pharmaceutical, biological, and antibiotic items.

Since its founding eighty years ago this May, Lilly has become one of the leading pharmaceutical manufacturers. Four manufacturing plants and an agricultural research farm spread over 1,000 acres in Indiana alone. And Lilly is expanding its international facilities, with plants in England, Canada, Mexico, and Brazil.

Drug manufacturing is an industry on which life itself may hinge. Because of this fact, the industry is probably second to none in the standards of product quality and uniformity it must maintain.

Each of the 1,175 chemicals used in drug manufacture by Eli Lilly and Company, for example, must be assayed for purity and potency and meet rigid specifications. America's chemical industry supplies all but a few of these chemical drug ingredients.

Because of the minute quantities of highly potent chemical ingredients used in making drugs, formulas are tested, checked, and rechecked at each step in the manufacturing process. Lilly frequently goes beyond the minimum requirements set by the Food and Drug Administration. And after production, every lot of medicine is assayed to make certain no errors have been made.

In biological processing, the amount of testing sometimes appears endless. In manufacturing polio vaccine, for example, production is completed in twenty days, but testing requires more than 110 days.

We have improved our scientific technique immensely since 1876 when Eli Lilly and Company was founded. But the basic principles of integrity and fair dealing which the founder initiated still continue. Consider some historical events that have led to Lilly's growth.

On a May day in 1876, Colonel Eli Lilly, then thirty-eight, first stepped into his 18x40-foot "laboratory" for making drugs in downtown Indianapolis.

Times were ominous. That was a depression year; money and credit were tight; business was down; there was widespread unrest and discouragement.

Judging by advertisements of the period, only "patent" medicines were flourishing. People of that era had come to expect complete relief from everything from cholera morbus to syphilis in a "patent" medicine bottle.

Had Eli Lilly been interested solely in making money, he could have better invested his \$1,300 capital in this sort of "sure-sell" medicine than in manufacturing standard pharmaceuticals for the medical profession.

But his training and character decided the course; he

This is the fourth in a series of articles on the origin, development, and product fields of the sustaining member companies of the Armed Forces Chemical Association which reflect the vital role of chemical science and industry in the National Defense. The next article in this series is scheduled for the July-August issue.—Ed.



Replica of the first Lilly quarters, an "18x40-foot laboratory" in downtown Indianapolis.

could only hope—not foresee—that in time science, education, and pure food and drug acts would make scientifically compounded drugs the surer as well as the more satisfactory form of medication.

From the day he entered his small shop for the first time, Colonel Eli Lilly's philosophy was to "make medicine, not to practice medicine." This idea has continued, and today Lilly products are still prescribed by the medical profession and dispensed by professional pharmacists.

THE NEW BUSINESS started slowly. Colonel Eli Lilly made the rounds of the drug trade, and when he had accumulated a bundle of orders for sugar-coated pills, fluid extracts, elixirs, and similar items, he returned to his shop to make them.

Since most of the early products offered were liquids, percolation was used extensively to extract active ingredients from crude drugs. Pills were also a popular form of medication in those days.

Compared with today's standards, production methods were extremely laborious. In making pills, round balls of pill dough were moved back and forth in grooves, changing their shape to oval. These pills were then placed on needle points, dipped in gelatin, and placed on revolving drums to dry.

Through employment of good business practices and production of quality ethical pharmaceuticals, the Lilly line grew. Within two years after its founding, the 18x40-foot quarters were too small.

Within another two years, a second move was made to the present location of the main offices in Indianapolis. By this time, Colonel Lilly was offering 312 fluid extracts, 189 sugar-coated pills, 199 gelatin-coated pills, fifty elixirs, fifteen syrups, and five wines. Wholesalers as far away as the West Coast were placing orders with Lilly.

In 1881, sales grew to \$66,000, and the business was first incorporated with \$40,000 capital stock and five stockholders.

Colonel Lilly's son, J. K. Lilly, graduated from the Philadelphia College of Pharmacy in 1882, and returned to Indianapolis to organize the company's first "Scientific Division."

Colonel Lilly died in 1898, after having guided his company through the depression of that decade. In his last years he gave unselfishly to improve Indianapolis' sanitation, health, schools, and transportation.

J. K. Lilly became president of Eli Lilly and Company upon his father's death. In his early years as president, he took his place with Lilly sales representatives, and was sometimes mistaken for one of them.

By 1905, with branch houses in St. Louis, New Orleans, and New York, and representatives in every state, Lilly had become a "national drug house." Three years later, the company purchased some 150 acres at Greenfield, Indiana, where the Lilly Biological Laboratories were constructed.

With World War I came the influenza epidemic—worst for its mortality rate since the Asiatic cholera two generations earlier. At this time, when medicines were most needed, the supply of raw materials needed in their manufacture was being curtailed by the war. To assure a supply of atropine salts, Lilly raised belladonna and stramonium (Jimson weed).

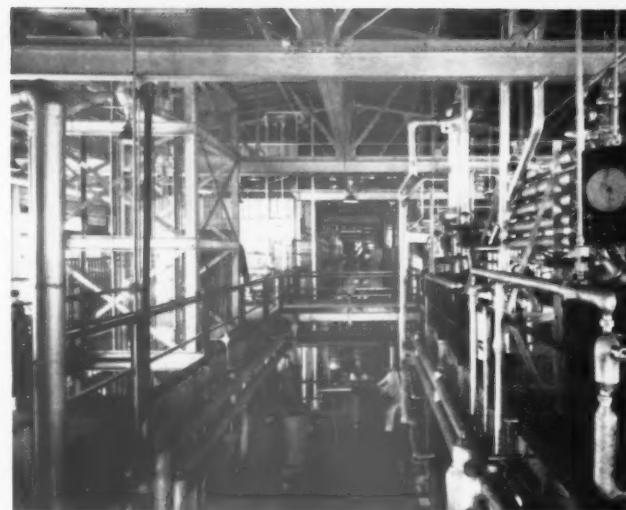
Besides supplying vital drugs for wartime need, J. K. Lilly and the company aided materially in financing and equipping the Lilly Base Hospital 32, which served in France from December, 1917, to April, 1919.

INSULIN discovery by Dr. F. G. Banting and his associates in Canada made medical news soon after World War I. Eli Lilly and Company was vitally interested in insulin, and invested hundreds of thousands of dollars to develop production methods.

By 1923, Lilly scientists had worked out procedures for making a pure Insulin, using the iso-electric precipitation method. This product, Iletin (Insulin, Lilly) has been a mainstay in the Lilly line for thirty-three years.

Insulin production is an example of extreme purification by chemical means, and illustrates the time and effort involved in producing many drug items. Pork and beef pancreas glands are ground and extracted in acidified alcohol. This extract is filtered, chilled, filtered again, vacuum evaporated, separated, purified in an

The Lilly Kentucky Avenue manufacturing plant, one of two in Indianapolis.



This view of the chemical manufacturing department at Eli Lilly and Company indicates the enormous power and engineering requirements.

ether wash, precipitated by sodium chloride, and a series of iso-electric precipitations are made until the desired purity is reached. This process requires about five months.

In the "roaring twenties" Lilly made other contributions to medicine. Coco-vitamins were offered—years before vitamins figured prominently in medicine. Ephedrine was isolated and its uses were established by Lilly scientists. And a number of sedatives, including 'Amytal' (Amobarbital, Lilly), were developed.

By 1926, fifty years after the company's founding, 1,500 employees worked at Lilly. New products in this era included the antiseptic 'Merthiolate' (Thimerosal, Lilly), and liver extract and other anti-anemia products.

The depression years of the thirties required some curtailment of activities, but Eli Lilly and Company did not release employees nor cut wages. Instead, jobs were reassigned, and the work week was shortened. This interest in the employees' welfare has enhanced Lilly's position in the Indianapolis area to this day.

In 1932, J. K. Lilly's elder son, Eli, was named president of the company, while J. K. Lilly was moved to the position of chairman of the board.

The extensive Lilly research laboratories were dedicated in 1934. These laboratories were considered to be the most modern of their time.

With the expansion of research activities and addition to its product line, Lilly spread its influence throughout the world. Eli Lilly and Company (Canada) Limited was organized in 1938, and Eli Lilly Pan-American Corporation and Eli Lilly International Corporation were set up a few years later.

Subsidiaries were established in Mexico, Brazil, and the Argentine in 1943 and 1944. In 1947, Eli Lilly and Company of India, Inc., was organized.

WORLD WAR II, fought from the arctic to the tropics, taxed the capacities of medical scientists and pharmaceutical manufacturers. Eli Lilly and Company armed physicians, surgeons, medical corpsmen, and nurses with more than 200 of its products.

These items were sent in great quantities: penicillin, typhus vaccine, tetanus antitoxin, gas-gangrene antitoxin, diphtheria toxoid and antitoxin, cholera vaccine, Japanese B encephalitis vaccine, sulfonamides, liver products, insulin, vitamins, and a number of sedatives. In addition, the company processed and delivered with-



Research in a pharmaceutical firm takes many forms. Here, a counter-current distribution machine is used to separate radioactive components of a chemical mixture.

out profit, more than 2,000,000 pints of blood plasma.

Following World War II, Lilly continued to add to its production facilities, acquiring a second major plant site in Indianapolis. In 1948, J. K. Lilly, a grandson of the founder and a son of J. K. Lilly, Sr., was named president of the Company.

During this period the Lilly research program was expanded even further. Today, over 400 persons are engaged in scientific research at Eli Lilly and Company.

One of the most effective antibiotics now available was discovered by Lilly scientists in 1952. It is erythromycin, a broad-spectrum antibiotic with bactericidal action.

To keep facilities abreast of needs, in view of the tremendous antibiotics market, Eli Lilly and Company purchased additional land at Lafayette, Indiana, in 1953. There, a \$20,000,000, 14-building plant was constructed for antibiotics production.

This plant includes push-button power handling, a two-of-everything electrical system, and submerged fermentation tanks for antibiotics production. Because of its forward planning, this plant was named one of the top ten manufacturing plants completed in 1954 by *Factory Management and Maintenance* magazine.

Besides construction of a \$20,000,000 plant, 1953 was a key year in Lilly history for other reasons. After the company had been headed by the Lilly family for seventy-seven years, Eugene N. Beesley (no relative of the Lilly family) was named president. Beesley, then forty-

The fourteen-building Lilly Tippecanoe Laboratories, named one of the ten most significant plants completed in 1954.



four, had twenty-four years of Lilly experience behind him when he took office.

In 1953, Lilly scientists first made small batches of Salk polio vaccine. And in this year, the company made the decision to launch a development program in agriculture, since the extensive research laboratories could well be used to probe for farm as well as human medicines.

A team of Lilly research scientists contributed basic knowledge to chemistry and pharmacy in 1954 by first synthesizing lysergic acid, a component of the ergot alkaloids. These alkaloids are highly useful in drugs used in childbirth.

During 1954, Lilly marketed its first major agricultural product—a cattle growth stimulant containing diethylstilbestrol, a hormone-like chemical. Lilly is a foremost producer of this chemical.

LILLY WAS ONE of the two pharmaceutical houses to furnish Salk polio vaccine for the mass trials of 1954. Over 400,000 children were given the vaccine to determine its effectiveness. During this time, Lilly engineers



Antibiotics production centers around huge, recessed fermentation tanks such as these shown at the Tippecanoe Laboratories.

completely remodeled a sizable building for polio vaccine production. The company gambled heavily in hope that the vaccine would be pronounced effective.

When the vaccine was pronounced effective in April, 1955, Lilly was one of six pharmaceutical manufacturers with knowledge of tissue culture technique necessary to produce polio vaccine. In 1955, about 20,700,000 doses of the polio vaccine released as both safe and effective bore the "Lilly" inscription. The Lilly goal now is 60,000,000 doses of polio vaccine in the first six months of 1956.

Today, pharmaceutical manufacturing is a highly competitive venture in business. The average new drug exists only about five years before it is replaced by an improved formula. It's easy to see, then, that the lifeblood of a pharmaceutical house is research.

At Lilly, the 400 scientific personnel are engaged in research in the following divisions: pharmacological; biochemical; organic chemical; biological; physicochemical; clinical; and medical. Agricultural research is a part of the Biochemical Research Division. Some 417 acres are now used for research in animal nutrition, veterinary medicine, plant pathology and physiology, and entomology and insecticides.

In its first eighty years, Eli Lilly and Company has grown in size and stature in its job of helping the cause of good health. Lilly hopes to repeat this success in its next eighty years.

ATOMS FOR MEATS (Continued from page 12)

To prove the wholesomeness of irradiated foods, long-term feeding studies are being conducted at several universities. These involve feeding treated foods to several generations of rats, dogs, or monkeys with studies of lactation, fertility, and histopathological examinations of vital organs and muscle and bone sections of sacrificed animals. Of particular interest is a study that has been undertaken at the Medical Nutrition Laboratory at Fitzsimmons Army Hospital in Denver. Nine volunteers have subsisted for thirty days on a diet, 35% of which had been irradiated. A second thirty day period, during which 65% of their caloric intake was irradiated food, had no apparent effect on these volunteers. Further tests, both with animals and with human volunteers, are being conducted in Denver.

Effect on Food Flavor Is Problem

THE FACT THAT WE ARE confronted with such a radical method of food preservation requires that extensive research must be done before the method may be considered acceptable. The biggest problem encountered to date is the fact that many foods acquire flavors different from those with which we are familiar in fresh or thermally processed foods. In some items (e.g., pork) the differences are slight, but in milk and milk products this is a serious obstacle. Studies to determine the exact mechanisms causing these flavor changes, the constituents which undergo change, and methods of reducing these changes are at present being explored by a number of both academic and industrial groups. Possible areas being considered include: control of temperature during and after irradiation, use of additives, packaging, and a combination of thermal and radiation sterilization. Determination of doses required to reduce bacterial populations in food samples to a desirable minimum is another basic problem, as is the observation of the effect of radiation on bacterial toxins. The fact that enzymes are extremely radioresistant poses the problem of inhibiting their action in radiation processed foods. Methods of protecting nutritional factors in foods must also be considered, since some essential amino acids and vitamins seem to be radiosensitive. Stability during postirradiation storage and handling under various conditions is under investigation, also the possible development of new packaging methods with materials still under development. The groups which are represented in this broad effort represent most of the recognized authorities in the field of food technology in this country.

In the President's budget message to Congress delivered on 16 January, it was announced that the Atomic Energy Commission had been requested to build a reactor designed primarily to deliver a relatively neutron-free intense gamma flux. This will form the heart of a so-called pilot plant which will enable large amounts of foods and other items of interest to the Armed Forces to be irradiated in lots large enough to satisfy the demands for quantities and to permit cost studies and development of processing methods to be conducted. Initially this plant will be primarily concerned with food problems, but as the feasibility of this processing method is proved to the point where industry is willing to invest in separate facilities, other radiation projects of interest to the Department of Defense will be undertaken. This facility may well become the major radiation research and development center in this country. It is hoped that this facility will be in operation late in 1958 or early in 1959.

WHILE MOST PROBLEMS IN connection with this process are partially solved or are under intense investiga-

tion, there are still areas which offer opportunity to the chemical industry. Most important at this time is to further explore the use of additives to reduce the production of undesirable flavor, color, and odor changes and to protect radiosensitive nutritional factors. To date those which seem to be most promising are anti-oxidants and free radical acceptors. The use of additives which might reduce the dose required to obtain the desired bacteriocidal effect is another possibility. Methods to inhibit certain enzymes which might cause undesirable changes in foods during storage will have to be tested. Possible requirements for new can liners may develop as more information is gained on storage studies. The development of a plastic foil which is oxygen-impermeable, suffers no undesired effects under irradiation, and is strong enough to permit handling by food distributors, is a necessity. Cellophane and celluloses in general tend to become brittle when irradiated, and polyethylene is gas permeable. The best solution to date is polyethylene-coated mylar. A plastic sealing compound which will not weaken under radiation is another need. Much work has been done in the field of megarontgen dosimetry, but more effort must be expended here. There is a need for a permanent type of dosimeter which could be attached to selected packages to be treated, as well as a method of rapidly integrating the total dose delivered to an item passed through an irradiation volume. These represent the areas of greatest challenge, but others will undoubtedly arise as the process is further developed.

Other Uses for the New Facility

WHILE THE RADIATION CENTER will be designed initially to process foods primarily, there are other projects which will utilize the facility. Some suggested areas of possible military interest include:

Vulcanization of rubber.

Polymerization of plastics and other chemicals

Catalysing other chemical reactions.

Prevention of mold or fungus growth on tentage, leather goods, etc.

Possible desirable changes in petroleum products, such as increased stability, molecular rearrangement, or changes in flash point and rate of burning

Aging studies

Effects on explosives and ammunition

Treatment of sewage

Neutron studies

Changes in crystalline structures of metals and alloys

Shielding studies

Sterilization of surgical packages and medicinals

The fact that about forty academic, industrial, and government groups are actively participating in the Radiation Preservation Project emphasizes the importance attached to this possible peaceful use of atomic energy. The idea of being able to ship perishable foods with minimum refrigeration requirements, the possibility of storing ever-fresh steaks on a pantry shelf indefinitely, and the treatment of grains, flour and potatoes so that they may be stored possibly for years without deterioration is an enticing one. The potentialities of simplifying some of the logistical problems of the Armed Forces has contributed to making this Project a fair-haired child in the Army's family of research and development programs. Although at this time no radiation-treated food has been cleared for consumption by any except selected volunteers, it is hoped that in the next two years the concerted effort of the team of investigators now working in this Project will have uncovered sufficient information to demonstrate whether or not the use of ionizing radiation to preserve foods is a safe, feasible, and acceptable method.

THE DIFFUSIONAL CONCEPT IN TOXIC AGENT PROTECTION

By

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IN THE USE of air purification devices the movement of contaminated air through a purification medium requires an expenditure of energy. Such energy is provided by the lungs in the case of a gas mask respirator, and is mechanical or electrical in nature when operating the motor-blowers of large air purification devices, or collective protectors. In the latter cases the energy requirements can be very high, and impose serious limitations in the design of practical items as well as in their application to general use in small protective shelters. In order to reduce to a minimum the expenditure of energy, in any form, necessary to achieve a specific protective level, great advantages can be realized by maximizing the diffusional mechanisms. The external energy-free, and therefore cost-free, contribution of these diffusional mechanisms can be added to, and becomes an integral part of the toxic agent protection built into a purification device.

PAST USE. Until recently the principal applications of diffusion to protective devices were concerned with the passage of gases from an air stream to the outer surface of an adsorbent, and in the Brownian movement of an aerosol particle within the vicinity of a filtration fiber. When concerned with toxic gas purification by adsorbent materials, such as the activated charcoal in gas mask respirators and collective protectors, the diffusivity or diffusion coefficient of the gas primarily applies to that portion of the adsorbent layer which is considered to be unsaturated with adsorbate when the device has completed its useful life. This unsaturated or ineffectively used volume of adsorbent is known as the critical layer, and its depth, in any geometric configuration used in the design of a purification device, is summarily called the critical bed depth. That this critical bed depth is primarily influenced by the diffusion coefficient of the gas being adsorbed can be shown by the Mecklenburg, mass balance, type of equation¹ when solved for the gas protective time, *t*, as follows:

A symposium on respiratory protective devices and their application to civil defense was conducted last year in Cincinnati under the auspices of the American Chemical Society. It was sponsored by the Division of Industrial Chemistry, of which Dr. E. W. Comings is chairman. Mr. Saul Hormats of the Chemical Corps was chairman of the symposium.

Representatives of the Army Chemical Corps, Naval Research Laboratory, Federal Civil Defense Administration, U.S. Public Health Service, and Office of Maine Civil Defense and Public Safety participated.

The following paper on the application of diffusional mechanisms in protection against toxic agents was one of those presented at the symposium. It is planned to publish additional selected papers presented at that meeting as it is believed that the information will be of interest to a considerable segment of the Association members, particularly those concerned with the civil defense program.—Ed.

GAS TEST EQUATION

$$t = \frac{N_o}{C_o V} [\lambda - \lambda_c]$$

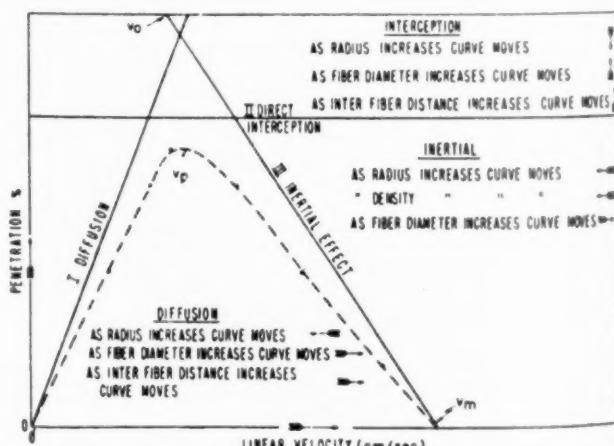
Where

$$\lambda_c = \frac{1}{a} \left(\frac{D_p V_p}{u} \right)^{0.41} \left(\frac{u}{\rho D_v} \right)^{0.67} \ln \left(\frac{C_o}{C_b} \right) + h_1 V \ln \left(\frac{C_o}{C_b} \right)$$

Equation 1

The first part of the equation for the critical bed depth, λ_c , involving both the Reynolds and Schmidt Numbers, is applicable when diffusion of the gas to the charcoal surface is rate controlling in the adsorption process; the second part when adsorption or reaction is controlling. In the former case it can be seen that since the gas diffusivity, D_v , occurs in the denominator of the Schmidt Number a decrease in its value will tend to increase the critical bed.

When applied to the mechanical filtration of aerosol particles by fibers or fibrous mats, the role played by diffusion of the aerosol can best be shown by the Ramskill and Anderson² curves on filtration mechanisms (Fig. 1).



Filtration mechanisms

Figure 1

Here again it can be seen that the diffusivity, when applied to filtration of aerosol particles, plays an important role at low linear velocities. The relationship of

particle size and velocity for any filter material can be determined both theoretically and experimentally. The above relationships have been used extensively to design protective devices of a conventional nature. An example of such design is seen in the Field, Collective Protector, M6, shown in Fig. 2. In such a design, to achieve protection with minimum power, extended surfaces for the charcoal adsorbent and the mechanical filter were required.

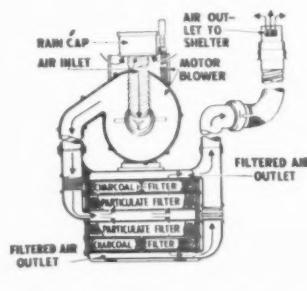


Figure 2

DIFFUSION BARRIER MATERIALS. A re-examination of Equation 1 shows that, under conditions where diffusion is rate controlling, a smaller critical bed depth, and subsequently greater protection, can be achieved by the use of a micronized adsorbent. Also, Figure 1 illustrates that in the case of a mechanical-type aerosol filter, a decrease in the diameter of the filtering fibers would result in increased arresting efficiency for sub-micron size particulates. Unfortunately, in the design of protective devices which operate on the forced flow principle, these advantages cannot be fully realized because of the critical balance which must always be maintained between protection and resistance to air flow, and the above treatments, which would tend to increase protection, abnormally increase the air resistance and power requirements of a system.

However, it was reasoned that the above advantages could be realized in a protective system based upon pure gaseous diffusion, where forced air flow would not be employed, and the barrier material could be densified, since resistance to mass flow would no longer be of major concern. Thus investigations were initiated to de-

velop materials to serve as reactive-type diffusion barriers which would allow the inward passage of oxygen for sustaining life, and the outward passage of vitiated air containing carbon dioxide and water vapor. Toxic gases were to be removed by a micronized adsorbent contained within the barrier material and aerosols would be filtered due to the inclusion of fine fibers. It was found that Fick's Law, Equation 2, very adequately described the action of a diffusion system using these materials:

Two types of materials have been developed, to date, for use as diffusion barriers (Fig. 3). One is a semi-rigid board, about one-quarter inch thick, and is similar in appearance to a commercial wallboard. It can be inexpensively produced on the standard commercial machinery of an industry which has a capacity in excess of three billion square feet per year. It is also readily adaptable to normal construction techniques in that it can be sawed, planed, sanded, and nailed. The second barrier material is a flexible mat, also of about one-quarter inch thickness, manufactured by a special dry-forming process. This material has found considerable use in applications where it is desirable to join the barrier to impermeable materials used as liners.

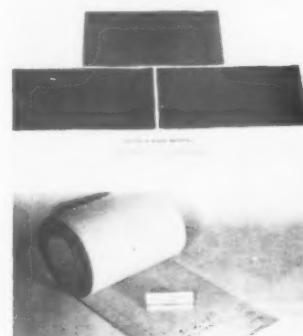


Figure 3

Each of the above materials has excellent gas arresting properties due to the direct inclusion of activated and impregnated charcoal in their composition, and their aerosol removal efficiency has never been exceeded by a forced-flow filter.

Application to C.B.R. Protective Devices

The work described herein in which maximum use was made of the diffusional mechanism might be compared to the industrial use of energy sources freely available in nature. For instance, manufacturing costs are greatly reduced by industry when maximum use is made of gravity flow processes, such as in the design of hydroelectric plants. It should be theoretically possible to achieve a protective system which is essentially power-free, in which concentration gradient acts as the sole driving force, and transfer per unit time of a gas or aerosol across a boundary surface can be controlled by either increasing the area of the barrier or decreasing its thickness.

Chemical Corps activity along these lines was revealed in a recent article by the Chief Chemical Officer, Major General William Creasy.³ Some applications of these methods to Civil Defense functions were also recently discussed by Dr. John Grebe,⁴ a former consultant to the Corps.

The basic principle in the design of a diffusional protective device, whether it be for a single person or a group of individuals, is to surround or inclose the protected volume with a sufficient quantity of barrier material to assure adequate protection and sustain life. Leakage

DIFFUSION EQUATION:

FICK'S LAW

$$-\frac{dm}{dt} = \frac{DA (C_1 - C_2)}{l}$$

MODIFIED AND TRANSPOSED

$$\% \text{ CO}_2 = \frac{k N l}{DA}$$

Equation 2

sources must be essentially eliminated so that the only means of exchange with the surroundings is through the barrier itself. Practically, it has been determined that, with the diffusional materials available, protection can be achieved by the use of very small barrier areas, and the main concern in design is satisfaction of the physiological criteria. In this respect, we have determined in the laboratory and verified by actual extended occupancy trials, that the provision of about ten square feet of barrier surface per occupant is sufficient to maintain the equilibrium carbon-dioxide concentration at or below the innocuous value of two per cent, and the other factors such as temperature and humidity fell within the limits of physiological acceptability.

While security limitations do not allow a full revelation of the specific methods and types of application we have been actively investigating, it can be stated that these diffusion materials have been used with success in the modification of protective devices, and have allowed us to consider collective protection for shelter types which are economically infeasible by conventional methods. Inside surfaces of shelters may be lined with the rigid board material, or small enclosures constructed within a room and fitted for emergency use. In most cases the conversion of a room, house, bunker, etc., to a protective shelter can be accomplished by the occupants themselves and, important from a military view, the external appearance and normal function of the protected area need not appreciably be altered by such treatment.

Experimental Tests

Experimental work has been concerned primarily with the development of test procedures capable of properly evaluating these new air purification materials.

The standard type of dynamic test on protective materials involved passing a toxic gas or aerosol into a sample material under flow conditions and observing its pressure drop and resultant protective life. The pressure drop of the material was due to its internal resistance and the air flow rate selected.

In the test procedures developed for the diffusional materials, conditions were imposed which were more realistic of actual use than air flow tests. Assuming the flows will be due to both concentration gradients and stagnation pressures caused by a wind velocity, a differential pressure test was devised. The major characteristics of this test are that the gas concentration, relative humidity, sample area, and pressure drop are fixed under test, and the contaminated air flow at or onto the surface of the sample is determined by the concentration gradients developed and the internal resistance of the material to air flow.

Two types of differential pressure tests were developed, designated as "sweep flow" and "penetrating flow" (Fig. 4). The "sweep flow" type used a flow of contaminated air on one side of the test sample and a flow of clean air on the other, the relative rates of flow being adjusted to cause a predetermined pressure differential. The high pressure side was always that containing the contaminated air. The protective life was determined to be that time when a trace of contaminant seeped through the sample material and was detected in the clean air flow. The "penetrating flow" type resulted from the technique whereby contaminated air, also at known conditions of concentration and humidity, was impressed upon the sample surface such that a positive pressure differential, of predetermined magnitude, was created between surfaces. The resultant flow through the sample, as was true for "sweep flow," became a function of concentration gradient and sample resistance to flow at the pressure drop utilized. The main difference, however, between this

DIFFERENTIAL PRESSURE GAS TESTS

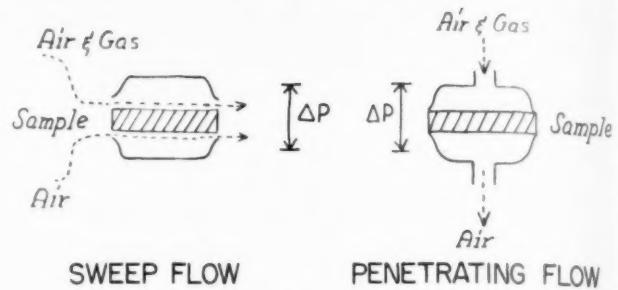


Figure 4

procedure and that of "sweep flow" was that in the latter case the static air film, at the clean air surface of the sample, was greatly reduced because of the sweeping flow. In the "penetrating flow" technique a true static film exists, decreasing the speed of transfer across the boundary.

A direct comparison of the results of both types of tests on a candidate material sample, at the same pressure differential, shown in Table 1, revealed a protective life for the material approximately three times greater when tested against a "penetrating flow" than a "sweep flow."

SAMPLE NO.	GAS PROTECTION @ ΔP OF $0.2'' H_2O$	
	SWEEP FLOW TEST	PENETRATING FLOW TEST
1	30	90
2	85	150
3	185	360
4	285	475

TABLE I. EFFECT OF TYPE OF DIFFERENTIAL PRESSURE TEST ON GAS PROTECTION OF MATERIALS

Protective Enclosure Tests

A series of human occupancy trials were conducted in an experimental protective enclosure (Fig. 5) constructed of diffusion board material. The shelter was 7 x 7 x 7 feet in dimensions and consisted of outer panels of diffusion boards, secured to an inner framework by nails and then taped to provide leakproof seals. A door was provided for entrance to the shelter, and after that was accomplished, it was securely sealed. A window provided visual contact between the occupants and the outside observers. The interior of the shelter was provided with food, bedding, and sanitary facilities sufficient for a two day occupancy. Both the internal and external portions were instrumented to determine occupancy characteristics. One of the main indices used to determine the conditions of occupancy was the carbon dioxide percentage within the shelter, and its rate of build-up. The steady-state or equilibrium values for carbon dioxide represented the maximum points obtainable under any given set of conditions. The rate of build-up was found to be rapid compared with the stay of occupancy, usually reaching a plateau in the rate curve after three or four hours. The maximum carbon dioxide percentages varied

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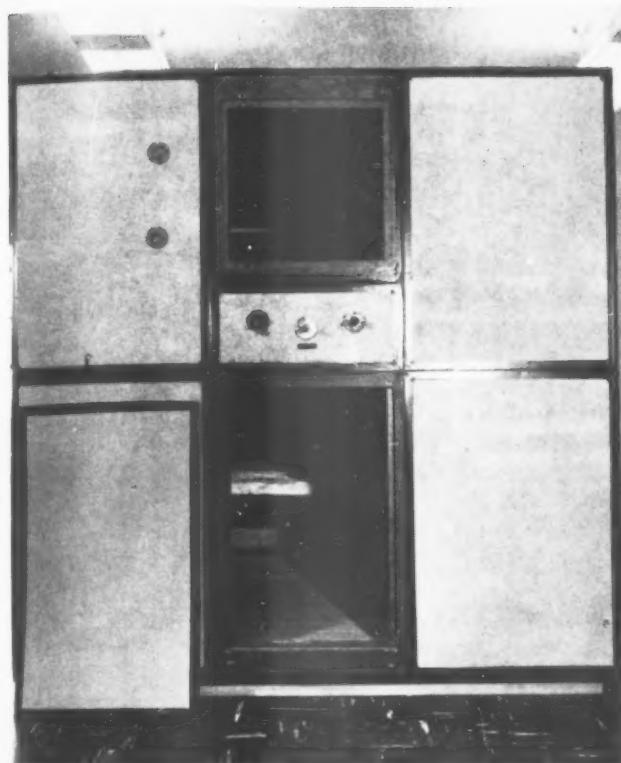


Figure 5

inversely with the area of diffusion board per occupant, the experimentally determined values agreeing very well with calculated values, as shown in Fig. 6.

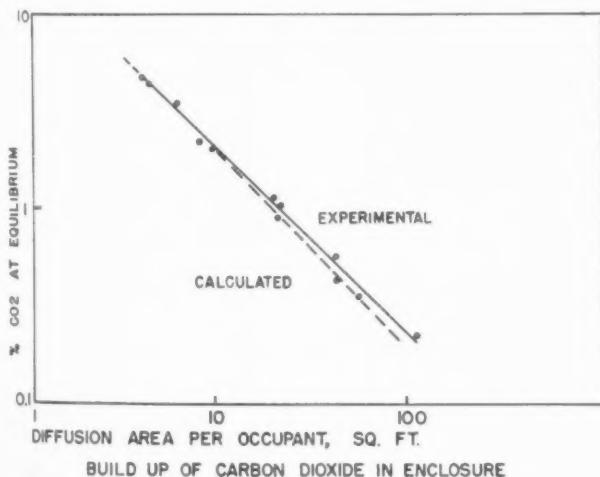


Figure 6

Equilibrium conditions were also reached within a few hours in regard to the temperature and relative humidity differential between the air inside and outside the enclosure. Table 2 shows that the average rise per enclosure occupant was 3.3° F. in temperature and 13% in relative humidity, over a wide range of test conditions.

Future Trends

The future development of methods, materials, and equipment which can be used to provide protection against toxic agents will continue the trend toward maximizing the contribution obtainable from diffusional processes. In this way the approach to non-mechanical means of power will be furthered, and consequently the dependence upon external sources of energy lessened.

Enclosure Atmosphere Increase Per Occupant	
Temp. °F.	% Rel. Hum.
3.2	7
3.0	10
3.9	18
2.8	12
4.1	19
3.0	12
2.9	10
3.3	12
3.9	18
3.3	15
Average 3.3° F.	13 %

TABLE 2: Increase in Protective Enclosure Atmosphere Caused Per Occupant Over a Wide Range of Test Conditions.

Coupled with this will be an effort to develop materials and equipment in pre-cut forms, and as packaged items. In all such developments the potential needs of the military and the civilian population will be considered. In this way it is intended to expand with the national "Do It Yourself" trend, so that with the use of kits, containing simplified instructions and pre-fabricated materials, the protective characteristics of diffusional materials can be utilized both by the soldier in the field and the man in his home.*

GLOSSARY

a	= surface per unit area, sq. cm. per cu. cm.
t	= protective life, min.
N _s	= saturation capacity, mg. per cu. cm.
V	= linear velocity, cm. per min.
C ₀	= initial gas concentration, mg. per cu. cm.
C _b	= breakpoint gas concentration, mg. per cu. cm.
A	= total bed, cm.
λ	= critical bed depth, cm.
dm/dt	= mass transfer per unit time, mg. per sec.
D, D _c	= diffusion coefficient, sq. cm. per sec.
A	= area exposed, sq. cm.
C ₁ - C ₂	= concentration gradient, mg. per cu. cm.
D _p V _D	= Reynold's number, dimensionless
$\frac{\mu}{D_p \rho}$	= Schmidt number, dimensionless
K ₁	= constant
1	= thickness, cm.
N	= number of shelter occupants

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CHEMICAL CORPS NEWS



MISS McCORMICK RETIRES

Miss Helen T. McCormick, upon her recent retirement after 38½ years' government service, was presented the Certificate of Achievement by Major General William M. Creasy, Chief Chemical Officer. The retirement ceremonies for Miss McCormick were held at the Gravelly Point offices of the Army Chemical Corps. Miss McCormick had served with the Corps since 1918.

CAREER MANAGEMENT SEMINAR

A three-day Career Management Seminar conducted in Baltimore, Md. February 15-17 was attended by some eighty members of the Army Chemical Corps. The Seminar, sponsored by Brigadier General Marshall Stubbs, Commanding General of the Chemical Corps Materiel Command, was designed to produce a greater awareness of management techniques and principles and to motivate Chemical Corps key military and civilian personnel to use these techniques in their duties.

Faculty members of George Washington University, Washington, D. C., conducted the conferences and were assisted by members of the Chemical Corps Training Command, Fort McClellan, Alabama.

In addition to Major General William M. Creasy, the Army's Chief Chemical Officer, commanders of the various Chemical Corps installations and agencies and a number of the management experts in business, Government and education addressed the meeting. These were:

Mr. William F. Rogers, Personnel Director for Giant Food Department Stores of Baltimore and Washington; Mr. Don C. Faith, Associate Professor of Educational Psychology, The George Washington University; Mr. H. DeWayne Kreager, Industrial Consultant, Washington, D. C.; Dr. B. H. Jarman, Professor of Education, The George Washington University; Mr. William Cacken, Jr., Chief,

Training and Development Division, Office of Civilian Personnel, G-1, Department of the Army; Dr. Calvin D. Linton, Professor of English Literature, The George Washington University, and Mr. Michael J. Kane, Vice-President, Training-Within-Industry Foundation, Summit, New Jersey.

COL. HENRY M. RUND RETIRES

On March 26 the Office of the Chief Chemical Officer, Department of the Army, held a reception at the Fort McNair Officers' Club in honor of Colonel Henry M. Rund, who retired from active service. Colonel Rund served as Executive Officer in the Chief's Office, Washington, D.C.

During retirement ceremonies a Certificate of Achievement was awarded to Colonel Rund and a special scroll was also presented to him.

Colonel Rund's previous assignments included duty as Adjutant General, Office of the Chief Army Field Forces in 1954, Adjutant General, The Infantry Center in 1953, and as Adjutant General in both the European Theater of Operations and the U.S. Forces in Austria. The Legion of Merit and Bronze Star Medal were awarded to Colonel Rund.

VACCINE FOR TULAREMIA

A vaccine for tularemia will be tested in prisoner volunteers at Ohio State Penitentiary by the Ohio State University Health Center under a contract with the Army Chemical Corps, the Department of the Army and the Ohio State University Research Foundation have announced.

The testing is a part of the Army's preventive medicine program. Tularemia, sometimes known as "rabbit fever" and "deer fly fever," has been a health problem of importance not only to the military but to the civilian population at large.

Volunteers will be vaccinated and later will be injected with small numbers of the bacteria causing tularemia in order to ascertain the effectiveness of the vaccine. Streptomycin, which produces an effective, extremely rapid cure for tularemia, will be used to treat prisoners who become ill.

The vaccine has been under development since 1933 by Dr. Lee Foshay and his associates at the University of Cincinnati College of Medicine. It has been used experimentally for several years.

In the past, prisoners at other institutions have assisted the government in similar tests important to the National Defense and Public Health.

MAINTENANCE REPRESENTATIVE

Mr. Jack McLaughlin, chief of the inspection office of the Eastern Chemical Depot at Army Chemical Center, has been appointed Chemical Corps Regional Maintenance Representative for the First and Second Continental

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Armies and the Military District of Washington. Mr. McLaughlin will assist commanders in providing proper organization and field maintenance of Chemical Corps equipment.

N.Y. CHEMICAL CORPS RESERVES MEET AT GOVERNORS ISLAND

Pictured at the head table at a dinner at Governors Island, N.Y., preceding the regular training session for



members of the N.Y. Chemical Procurement District Reserve Augmentation Group, Detachment #10 are, left to right: Colonel William Anuskevicz, Sperry Gyroscope Company, Long Island, executive officer of the Group; Colonel T. P. Gahan, First Army Chemical Officer; Colonel T. H. Marshall, Lederle Laboratories, Pearl River, N.Y.; and Colonel N. B. Wilson, Chief of the First Army Reserve Forces Group.

NEW PINE BLUFF X-RAY LAB

A new X-ray laboratory has been dedicated at Pine Bluff Arsenal by Colonel William H. Greene, Arsenal Commander, Major Robert W. Lane, Chief of Quality Surety (Inspection) and Mr. Paul Edmiston, Chemical Corps Materiel Command Radiographic Technologist who designed the building and facilities. The new lab will be used to perform non-destructive tests on all items manufactured or stored at the Arsenal to which radiographic examination can be applied. While non-destructive testing is not a recent development in inspection of munitions, its application in the Chemical Corps field is recent.

Formerly a specified number of items to be tested were actually used (destroyed) to check their performance. Now, by the use of X-ray, such inspections can be performed with greater economy, speed and safety.



Left to Right, Col. W. H. Greene and Maj. R. W. Lane look on as Mr. Paul Edmiston manipulates the 1,000 KVP X-ray unit into position.

CHEMICAL CORPS WIVES ELECT

The Chemical Corps Wives' Club elected officers at a Valentine's Day luncheon meeting at the Old Club Teahouse, Alexandria, Va. on February 14. Honorary President, Mrs. William M. Creasy, wife of Major General Creasy, pins an orchid on past President, Mrs. William



H. Foley, as the newly-elected President, Mrs. Benjamin R. Bierer of Arlington, Va. approvingly looks on. Other newly-appointed officers are: Mrs. Edgar R. McDaniel, Vice President, Mrs. Clyde H. Westbrook, Secretary, and Mrs. Owen R. Mullen, Treasurer.

GERMAN SCIENTIST AT A.C.C.

Dr. Albert Pfeiffer, a German scientist whose World War II assignment was to design and produce 30,000 fog cannons with which the Wehrmacht could conceal any invasion coast in three seconds is now working for the Army Chemical Corps on airborne sprays according to a recent announcement from the Army Chemical Center, Md. By the time Dr. Pfeiffer had designed the fog cannon, Allied bombers had so damaged the manufacturing plants it could not be produced.

Dr. Pfeiffer, the announcement states, was born in Weissenburg, Bavaria, and studied under Roentgen, discoverer of the X-ray, at the University of Munich.

STUDIED ENGLISH FOGS

Dr. Van A. Sim, scientist at the Medical Laboratories at Army Chemical Center, Md., recently returned from a study of English fogs. Working with a British experimental project, the Chemical Corps researcher found evidence to indicate that the larger and wetter the droplets were, the more irritating the smog. Some tests were made on substances which had a neutralizing effect on the irritant elements believed to be components of the industrial vapors, Dr. Sim said.

INDUSTRY ADVISORY COUNCIL

A Chemical Corps Industry Advisory Council, composed of executives of industries in the fields related to the work of the Corps, has been appointed by Major General William M. Creasy, Chief Chemical Officer, Department of the Army, to assist in solving some of the problems confronting the Corps in the areas of management, engineering, procurement, manufacturing and facilities.

The 34 industry members of the Council represent a broad cross section of the chemical, bacteriological, radiological and allied scientific fields. General Creasy also named Rear Admiral Nathaniel S. Prime, USN (Ret.),

President, Armed Forces Chemical Association, Washington, D.C. as a member of the Council. Many of the companies represented are members of this Association, and many of the individual members are also members of the Industrial Advisory Council of A.F.C.A., but the two Councils are separate organizations.

Brigadier General Marshall Stubbs, Commanding General of the Chemical Corps Material Command, has been appointed Chairman of the Council. Mr. Leo F. Walsh, Industrial Adviser in the Office of the Chief Chemical Officer, has been named Vice-Chairman and Executive Director.

Industry members of the Council are:

G. L. Armour, President, American Aniline Products, Inc., New York, N.Y.
S. Askin, President, Heyden Chemical Corp., New York, N.Y.
Matthew M. Berman, President, L. E. Mason Co., Boston, Mass.
Rear Admiral C. M. Bolster, USN (Ret.), Director of Research, The General Tire and Rubber Co., Akron, O.
L. A. Brand, Vice-President, Empire Stove Co., Belleville, Ill.
Walter Burroughs, Eldon Manufacturing Activity, Los Angeles, Calif.
John E. Caskey, Vice-President and General Manager, Naugatuck Chemical Division, United States Rubber Co., New York, N.Y.
John E. Cohill, Assistant to the President, The Firestone Tire and Rubber Co., Akron, O.
Paul L. Davies, President, Food Machinery and Chemical Corp., San Jose, Calif.
Louis Degen, Treasurer, Shwayder Brothers, Inc., Denver, Colo.
Fred Denig, Vice President and Manager, Production Dept., Koppers Co., Inc., Pittsburgh, Pa.
Ralph L. Evans, President, Evans Research and Development Corp., New York, N.Y.
Aiken W. Fisher, President, Fisher Scientific Co., Pittsburgh, Pa.
William P. Gage, President, Grace Chemical Research and Development Co., New York, N.Y.
Edward W. Gamble, Jr., Regional Vice-President, Monsanto Chemical Co., Washington, D.C.
L. S. Gray, President, Gray Stamping and Manufacturing Co., Plano, Ill.
John J. Grebe, Director, Nuclear and Basic Research Department, The Dow Chemical Co., Midland, Mich.
Walter Haertel, President, Walter Haertel Co., Minneapolis, Minn.
R. W. Hooker, Vice President, Hooker Electrochemical Co., Niagara Falls, N.Y.
T. G. Hughes, President, Oronite Chemical Co., San Francisco, Calif.
Dan A. Kimball, President, Aerojet-General Corp., Azusa, Calif.
H. L. Loynd, President, Parke, Davis and Co., Detroit, Mich.
R. C. McCurdy, President, Shell Chemical Corp., New York, N.Y.
Col. Louis W. Munchmeyer, Assistant General Manager, Wyandotte Chemicals Corp., Wyandotte, Mich.
Thomas S. Nichols, President, Olin Mathieson Chemical Corp., New York, N.Y.
William B. Plummer, President, Indoil Chemical Co., Chicago, Ill.
R. B. Rohrer, Assistant Director, Research and Development Center, Armstrong Cork Co., Lancaster, Pa.
J. T. Ryan, Jr., President, Mine Safety Appliances Co., Pittsburgh, Pa.
M. L. Sheely, Technical Director, Armour and Co., Auxiliaries Group, Chicago, Ill.
O. G. Vinnedge, Vice-President, Dryden Rubber Division, Sheller Manufacturing Corp., Chicago, Ill.
H. A. Wansker, Director of Government Operations, Carr Fastener Company Division, United Carr Fastener Corp., Cambridge, Mass.
Charles B. Weeks, General Manager, Hesse-Eastern Division Flightex Fabrics, Inc., Cambridge, Mass.
Earl L. Whitford, President, Oldbury Electro-Chemical Co., Niagara Falls, N.Y.
H. H. Wolfert, Vice-President, National Fireworks Ordnance Corp., West Hanover, Mass.

DUGWAY'S BLIND CHEMIST

DUGWAY PROVING GROUND, UTAH—Dr. Richard Wilburn, who has been blind since he was four years old, has joined the research staff of the Chemical Warfare Laboratories at Dugway Proving Ground, where he will specialize in physical chemistry. He was formerly a research chemist in the Morse Consulting Laboratory in Sacramento, Calif.

Dr. Wilburn was born in Hayworth, Illinois. As a result of losing his eyesight in an auto accident, he attended a school for the blind through his second year of high school. He completed his secondary training in a public high school. He majored in chemistry at the University of Washington, Seattle, where he was awarded BS, MS and PhD degrees. During his college career, Dr. Wilburn employed non-chemists as readers and labora-

tory assistants. The laboratory assistants performed at his direction those parts of experiments, such as weighings on analytical balances and titrations, which require vision. In many of his graduate courses, he made tape-recordings.

Dr. Wilburn states that school authorities and the general public tend to adopt one of two extreme attitudes toward blind students—either they help the blind person so much that he has little chance to learn, or they bar him completely from schools and employment. Many blind persons, he says, feel that blindness is not a mental or psychological handicap but a physical nuisance, and they would like to have others treat them as if this were the case. Dr. Wilburn feels he has been unusually fortunate in the attitude he has encountered in school authorities.

IT'S FORT DETRICK NOW

Recent Department of the Army orders changing the name of the site of the Chemical Corps biological warfare laboratories at Frederick, Md., from "Camp" to "Fort" Detrick were greeted enthusiastically by personnel at Fort Detrick and nearby residents.

The change constitutes formal recognition by the Army of Fort Detrick's permanent status.

Fort Detrick is the site of what used to be a municipal airport. It was dedicated as Detrick Field in 1931 by the 104th Aero Squadron, honoring Major Frederick Louis Detrick, a World War I flight surgeon who died in 1929 after having been an active member of the squadron for several years. The site was acquired by the federal government.

PORTABLE SHELTER FOR BABIES



A portable shelter designed to protect babies against some of the hazards of modern warfare has been developed by the Army Chemical Corps, and is being modified for civilian use with financial aid from the Federal Civil Defense Administration. The aim is to build a crib which can be produced and marketed in mass quantities for less than \$25.

The "Infant Protector," a plastic and metal crib resembling a small pup tent, has a new, chemically-treated filter paper "ventilator." It allows air to pass in and out for breathing, but filters out poison gas, bacteria and radioactive particles.

The crib differs from a World War II model which required continual operation of a bellows to keep the baby supplied with air.

FCDAs officials emphasize that the "Protector" will not guard a baby from blast or the gamma ray radiation of fallout dust collecting on the outside skin of the plastic shelter. This still would have to be washed, dusted or blown off.

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AGRICULTURAL CONTROL PROGRAMS

(Continued from page 19)

been described in the United States but not elsewhere (though it is shrewdly suspected that VE exists unreported in countries where foot-and-mouth disease is endemic). Race 15B stem rust of wheat was first found on a barberry plant in Iowa. In our livestock and plant shipments to other countries we protect them by sanitary precautions just as they help to protect us. And, imports of various kinds from abroad help us to develop plant resources, particularly, that better overcome the hazards of weather, diseases, and insects.

Plant breeders know that parent stocks from primitive sources are most promising in providing immunity to plant hazards. Plants that have survived, often for centuries, in their native habitats have developed a hardiness and disease resistance that can be combined with those we already have to produce superior strains and varieties. To name only a few examples: The blight-resistant Chinese chestnut is increasingly in demand for home and orchard plantings in areas of the East where native chestnuts once grew. Mosaic-tolerant sugarcane were imported from Java in the 1920's to save the sugarcane industry of this country. Rust-resistant strains of wheat from Kenya Colony and protectorate (British East Africa) were used in a breeding program that is expected in the next couple of years to restore the durum wheat industry to its former productivity. In fact, there is hardly a commercial field crop in America today that does not owe its disease resistance, its cold or heat tolerance, its insect resistance to germ plasm introduced from somewhere else in the world.

The same progress has not been made in the animal field, largely because the problem is different, selection in plants is easier, faster, and less expensive, and very little work has thus far been done in selecting and breeding animals for disease resistance. It is one of the fields that remains open. The breeding of disease-resistant animals can be of great assistance to us in local crises or those of national scope, in current emergencies or those yet to come.

DAY-TO-DAY experience with old, new, and unusual problems is helping the Agricultural Research Service and its cooperators in the States to improve its defenses against animal and plant diseases, and its means of control should they breach the defenses. Information is constantly being gained from epidemiological investigations at home and abroad. Diagnostic techniques are being developed and improved. The Animal Disease Eradication Branch of ARS is establishing a national animal disease reporting service, for the first time in the history of the country. Control and eradication methods for dealing with plant and animal pests and diseases are being constantly strengthened and improved. Additional research facilities are being developed. New and significant research is being done. New and penetrating questions are being asked, such as: Where did the mucosal diseases come from? Are they another series of obscure importations? If they develop in this country, where have they been—running a course in wild animals, hence not heretofore discovered?—vegetating in bodies of apparently well animals? Or, are they virus mutations that stem from known diseases such as shipping fever? Basic research may be required to answer these questions.

Bacteriological warfare, as waged by Nature, is nothing new. It is here and has been here in the everyday crisis, the routine emergency, confronting those who, day in and day out, year in and year out, battle the diseases and insect pests of plants and animals. Peacetime warfare against pest and disease has been the basic training of

men engaged in this line of work. A larger emergency would only put the program into high gear, mobilize the reserves, throw shock-troops into the fight where the battle is fiercest. Things will have to be learned, some of them fast and some of them the hard way. But bone-hard work and high ingenuity on the part of dedicated Federal, State and private workers has discerned the problems and mapped the strategy. They will know where to go and what to do in a national emergency.

SAN FRANCISCO TEACHER AWARD



Nobel laureate Dr. Glen Seaborg congratulates the San Francisco Chapter's nominee for the "A.F.C.A. Award for Secondary School Education in Science and Mathematics." The nominee, Mr. Robert Rice, chairman of the Science Department at Berkeley High School (Berkeley, Calif.), was presented with a cheque for \$100 as the outstanding chemistry teacher in the San Francisco Bay Area. Along with Mr. Rice, four other Bay Area chemistry teachers were awarded engraved desk sets at the Chapter meeting held at the Presidio of San Francisco Officers' Mess, Wednesday night, March 28. Dr. Seaborg, the guest speaker, chose as his subject "Scientists of Tomorrow." In his address he advocated, among other things, starting science education in the first grade. Pictured are, from left to right, Mr. Rice; Mr. Elliot Schrier, Chapter president; Mr. Phil Fitzgerald, chairman of the Chapter's Award Committee; and Dr. Seaborg.

The A.F.C.A. Executive Committee at its monthly meeting in Washington, D.C., on April 16, adopted a resolution commending the San Francisco Chapter for its exemplary work in furthering the Association's Science Teacher award program.

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GEN. McAULIFFE TO JOIN AMERICAN CYANAMID CO.

General Anthony C. McAuliffe, Commander-in-Chief of the U. S. Army in Europe, who served as Chief Chemical Officer of the Army from October 1949 to June 1951, has applied for retirement from active service effective May 31, 1956.

Mr. K. C. Towe, President of American Cyanamid Company, with offices at 30 Rockefeller Plaza, New York 20, N.Y., recently announced that General McAuliffe is joining that company as General Manager of its newly created Engineering and Construction Division.

FORMER AFCA DIRECTOR HEADS MISSILE PROGRAM



Mr. Eger V. Murphree, of Summit, New Jersey, President of the Esso Research and Engineering Company, has been appointed to the newly created position of Special Assistant to the Secretary of Defense for Guided Missiles. Mr. Murphree is a member of A.F.C.A. and served for several years as one of the directors at large of the Association.

In his new capacity, Mr. Murphree will be responsible for the direction and coordination of all activities in the Department of Defense connected with the research, development, engineering and production of guided missiles, except those types already adopted for service use. He is expected to devote major emphasis to missiles of the long-range type, particularly ballistic missiles.

During World War II, Mr. Murphree served as a member of the Office of Scientific Research and Development S-1 Committee, headed by Dr. J. B. Conant. This committee was instrumental in the establishment of the Manhattan Project which developed the atomic bomb.



A.F.C.A. HONOR TO MR. ROSENFIELD

FOR MERITORIOUS SERVICE—For the second consecutive year, David A. Rosenfeld (center) of the Engineering Command, Army Chemical Center, receives an award for the part he played in recruiting new members for the Edgewood chapter, A.F.C.A. His citation was an engraved bar with chain, which was attached to the plaque he received last year. Colonel William J. Allen, Jr., commanding officer of the Engineering Command, is on the left and Gerald J. Fleming, president of the Edgewood chapter, is on the right.

THE HISTORICAL CORNER

By BROOKS E. KLEBER*
Prisoners of War at Edgewood

Manpower is a war-waging essential with which the United States has not always been overly blessed. In World War II the Chemical Warfare Service requirement for an increasing number of civilian personnel—in 1939 it employed 1,355 civilians, in 1942, 25,611—was met only with the greatest difficulty.

Prisoner of war labor was one method which helped to overcome this personnel shortage. German, Italian, and Japanese prisoners performed housekeeping duties, and those activities permitted by the Geneva Convention, at various CWS installations. In addition, prisoners of war did support work for CWS projects at non-chemical posts.

More than 1,900 PWs operated gas mask and gas mask carriers disassembly plants at Camp McCoy, Wis.; Pine Camp, N.Y.; Camp White, Ore.; Ft. Devens, Mass.; and Camp Grant, Ill. under the aegis of the appropriate chemical warfare procurement district. Another 1,900 prisoners performed Convention-permitted work at the four chemical warfare arsenals, Desert Chemical Warfare Depot, and Dugway Proving Ground. Of these, Edgewood Arsenal, with over 700 prisoners, had the largest contingent.

The Geneva Convention of 1929 specified the conditions of PW housing, food, clothing, medical care, and discipline as well as labor. The prisoners at Edgewood lived in theater of operation type barracks, although a small percentage were housed in winterized tents. For the most part, prisoners received the same rations as did American troops stationed in the zone of interior. Station hospital facilities were available to the PWs, and post doctors and dentists treated the prisoners daily at a dispensary within the stockade. Discipline was strict; punishment received by prisoners was as severe and swift as the Geneva Convention permitted.

The Convention prohibited the use of prisoner of war labor in any activity having a direct relation to war operations. Although this circumscribed their use, prisoners were nonetheless employed in mess halls, warehouses, motor pools, the commissary, and the station hospital, among other activities. Some PWs at Edgewood were farmed out, so to speak, and worked for various Harford County farmers. For this kind of activity the post dealt directly with the county agent, the representative of the War Foods Administration.

At first PWs were assigned to duties without much regard for their military or civilian backgrounds. After a period of relative inefficiency, the prisoners were interviewed and then given jobs on the basis of MOS numbers and civilian occupations. This system greatly increased the efficiency of prisoner of war labor.

*Member of the Staff, Historical Office, Office of the Chief Chemical Officer.

FRANK KROPIUNIK

A.F.C.A. Headquarters has learned with deep regret of the death of Mr. Frank Kropiunik, who was a Charter Member of the Association. Mr. Kropiunik, who resided at Rocks, Maryland, died on February 16, 1956.